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OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: Preliminary Ecological Risk Assessment for Registration Review of Acephate

FROM: Donna R. Judkins, Biologist
R. David Jones, Senior Regulatory Advisor
ERB2/EFED (7507P)

Digitally signed by DONNA JUDKINS Date: 2017.03.21 14:12:48 -04'00'
2017.03.21 14:18:30 -04'00'

THROUGH: James Lin, Environmental Engineer
Christina Wendel, Biologist
Elyssa Arnold, Risk Assessment Process Leader
Brian Anderson, Branch Chief
ERB2/EFED (7507P)

Digitally signed by Lin, James Date: 2017.03.21 14:24:46 -04'00'
2017.03.21 14:42:47 -04'00'
Digitally signed by Arnold, Elyssa Date: 2017.03.22 07:36:12 -04'00'
Date: 2017.03.22 14:18:23 -04'00'

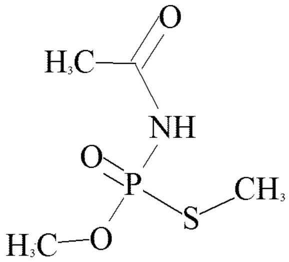
TO: Caitlin Newcamp, Chemical Review Manager
Nicole Zinn, Chemical Review Manager
Neil Anderson, Branch Chief
RMIB1/PRD (7508P)

This memorandum transmits the preliminary ecological risk assessment for the registration review of acephate. Based on currently registered uses and labeled rates, this preliminary assessment identifies risks to non-target organisms including birds, mammals and terrestrial invertebrates. This assessment is focused on species that were not Federally listed as threatended or endangered (referred to as "listed"); however, some general discussion of listed taxa is included.

Because acephate degrades rapidly to methamidophos (a pesticide active ingredient no longer registered in the United States), and methamidophos is more toxic than acephate to most taxa, this risk assessment assumes that acephate completely first converts to methamidophos before further degrading. Risk estimates were generally calculated on the methamidophos residues—for those taxa and use patterns where acephate risk is greater, the risks based on acephate are presented. Based on this preliminary assessment, there are strong indications of risk to terrestrial and aquatic animals from acephate use at most application rates with a high degree of certainty, and some indications of potential risk to aquatic and terrestrial plants from some uses.

Ecological Risk Assessment for the Registration Review of Acephate

USEPA PC CODE 123301



Prepared by:

Donna Reed Judkins, Ph.D., Biologist
R. David Jones, Ph. D., Senior Agronomist

Reviewed by:

Christina Wendel, MS, Biologist
James Lin, Ph.D., Environmental Engineer

Approved by:

Brian Anderson, MEM, Branch Chief,
Elyssa Arnold, MEM, MPH, Risk Assessment Process Leader
Environmental Risk Branch II

Environmental Fate and Effects Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

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1. EXECUTIVE SUMMARY

Acephate (O, S-dimethyl acetylphosphoramidothioate) is a systemic, organophosphate insecticide.

1.1. Use Summary

Acephate is currently registered for use on a variety of field, fruit, and vegetable crops; in food handling establishments; on ornamental plants both in greenhouses and outdoors (including lawns, turf, and cut flowers); and in and around the home.

1.2. Environmental Fate

Acephate degrades rapidly in the environment by microbial metabolism with a mean aerobic soil metabolism half-life of 1.5 d and somewhat more slowly in a single anaerobic aquatic metabolism study ($t_{1/2}$= 6.6 d). Acephate predominantly degrades to methamidophos in aerobic soils with conversion efficiencies ranging from 10 to 100%. Hydrolysis of acephate is relatively slow at pH 5 ($T_{1/2}$ = 325 d) and the rate increases with pH ($T_{1/2}$ @ pH 9 = 618 d). There is no evidence of aqueous or soil photolysis. Both acephate and methamidophos are considered highly mobile, with K_{oc}s of 2.7 $L{\cdot}kg^{-1}$ and 0.9 $L{\cdot}kg^{-1}$, respectively. Neither acephate nor methamidophos is expected to be a concern in ground water because they degrade rapidly in the soil. While methamidophos is considered semivolatile, with a vapor pressure of 10^{-5} torr, neither acephate nor methamidophos is expected volatilize because they are so soluble in water (~815 $g{\cdot}L^{-1}$ and 200 $g{\cdot}L^{-1}$ respectively).

1.3. Ecological Effects

Acephate is moderately toxic to freshwater and estuarine/marine invertebrates, practically non-toxic to freshwater fish, and slightly toxic to estuarine/marine fish on an acute exposure basis. Acephate is moderately toxic to avian species on an acute oral and subacute dietary exposure basis, and moderately toxic to mammals on an acute oral exposure basis. Acephate is classified as highly toxic to terrestrial invertebrates on an acute contact exposure basis. Chronic exposure to acephate resulted in reduced reproduction and survival in aquatic invertebrates and reduced growth, reproduction and survival in birds and mammals. The pollinator studies associated with EPA's recently developed pollinator risk assessment guidance have not yet been submitted, constituting a data gap. In general, the degradate methamidophos is more toxic than the parent compound.

1.4. Predominant Risk Concerns

Because acephate degrades rapidly to methamidophos, and methamidophos is more toxic than acephate to most taxa, aquatic risk assessments are based on the assumption that acephate completely converts to methamidophos and both exposure and toxicity estimates are derived for methamidophos; the terrestrial risk assessment is based on both acephate and methamidophos toxicity and exposure estimates. Further degradation of methomidophos breaks down the organophosphate moiety.

A summary of risk conclusions is presented in **Table 1**. Birds (also surrogate for reptiles and terrestrial-phase amphibians) and mammals had risk level of concern (LOC) exceedances for all foliar uses of acephate, with RQs in the tens and hundreds for agricultural uses and in the thousands for ornamental uses. Acute LOCs were exceeded for birds and mammals consuming seeds, even consumption of as little as a single treated seed producing a risk of concern. Numerous bird incidents were associated with acephate and/or methamidophos residues; methamidophos was identified in bird tissues in two incidents. There were 1611 domestic animal incidents associated with acephate in the Incident Data System. Terrestrial invertebrates have similar RQs to those of birds and mammals and multiple bee-kill incidents have been associated with acephate and/or methamidophos exposure. Aquatic invertebrates have RQs as high as 67, fish as high as 1.9 (both from the group of uses that includes roses and ornamentals uses and are based on worst-case scenarios due to non-specific application rates); risks to plants did not exceed the LOC for uses other than from that highest group, but incident reports raise a question of whether plants present in treated areas may be damaged by direct spray of acephate-containing products, though causality was uncertain for incidents involving products that are still registered.

Table 1. Summary of Risk of Direct Effects to Taxonomic Groups from Registered Uses of Acephate.

<table>
<tr><th rowspan="2">Use</th><th colspan="7">Risk Conclusion: YES (Bold Shaded), POSSIBLE[1] (Bold Italics), or NO (No Bold, Italics or Shading)
With Notes on Level of Risk to Each Taxonomic Group</th></tr>
<tr><th>Mammals</th><th>Birds, Reptiles and Terrestrial-Phase Amphibians</th><th>Fish and Aquatic-Phase Amphibians</th><th>Terrestrial Invertebrates</th><th>Aquatic Invertebrates</th><th>Terrestrial Plants</th><th>Aquatic Plants</th></tr>
<tr><td>A) cotton seed treatment</td><td colspan="2" rowspan="2">□ High to Very High Toxicity
□RQs up to 855 for cotton seeds and 527 for peanuts
□Consumption of <1 treated cotton or peanut seed can kill a small bird or mammal.</td><td colspan="5" rowspan="2">□Exposure unlikely to reach toxic thresholds due to seed burial</td></tr>
<tr><td>C) peanut seed treatment</td></tr>
<tr><td>F) cranberry</td><td rowspan="4">□High Toxicity

□ LOC exceedances for all uses—acute RQs up to 39; chronic RQs up to 1230

□Domestic Animal Incidents associated with acephate use</td><td rowspan="3">□Very High Toxicity

□LOC exceedances for all uses—acute RQs up to 303; chronic RQs up to 472

□Scores of incidents associated with acephate use – including incidents with probable and highly probable causality</td><td>□Application method makes exposure unlikely to reach toxic thresholds</td><td rowspan="7">□High Toxicity

□LOC exceedances—RQs from 1.1 to 774

□Bee-kills associated with acephate use – including incidents with probable and highly probable causality</td><td>□No LOC exceedances, but caution due to high toxicity and solubility</td><td colspan="2">□Exposure unlikely to reach toxic thresholds due to application method</td></tr>
<tr><td>L) mint
O) tobacco
S) rights-of-way</td><td rowspan="3">□No LOC exceedances, but, caution due to:

□Moderate Toxicity

□Solubility 3-4 orders of magnitude above toxicity

□Fish-kills associated with acephate use – one incident possibly caused by registered use</td><td>Risk/ Low Cert.
□Acute List-spp. LOC exceedances—RQs 0.12-0.43</td><td rowspan="4">□No LOC exceedances

□No toxicity seen in highest treatment tested, but caution due to plant incidents possibly associated with acephate use</td><td rowspan="5">□No LOC exceedances,
□Toxicity in mg/L range while exposure in µg/L</td></tr>
<tr><td>B) wasteland
D) peppers, non-bell
G) soybeans
I) beans
J) cauliflower
K) celery
L) mint
M) peppers
N) peanuts
P) lettuce
Q) cotton
R) southern pine orchard seedlings
T) alfalfa
U) grapes 1
V) citrus 2
W) grapes 2
X) talmonds, non-bearing
Y) apples, non-bearing
Z) Bermuda grass
E) Christmas trees
AA) citrus 1
AB) sod farms</td><td rowspan="3">□Very High Toxicity

□LOC exceedances—acute RQs up to 8; chronic up to 13

□Solubility 4-5 orders of magnitude above toxicity</td></tr>
<tr><td>AC) golf course turf
AD) fire ants</td><td>□Methamidophos in bird tissues from acephate use on fire ants</td></tr>
<tr><td>AE) roses</td><td rowspan="3">□Above concerns, plus acute RQs up to 409; chronic RQs up to 12800</td><td rowspan="3">□Above concerns, plus acute RQs up to3160; chronic RQs up to 4910</td><td rowspan="3">□Above concerns, plus LOC exceedances—chronic RQs up to 1.9</td></tr>
<tr><td>AG) non-residential buldings</td><td rowspan="2">□Above concerns, plus acute RQs up to to 67; chronic up to 113</td><td rowspan="2">Risk/ Low Cert.
□Above, plus List-spp. LOC exceed—RQs to 2.8; cannot preclude Non-list. exceed. bec. tox. data below app. rate.</td></tr>
<tr><td>AF) ornamentals</td><td>Risk/ Low Cert
□Listed-spp. LOC exceedance—RQ 1.2</td></tr>
</table>

[1] POSSIBLE is used with decisions based on lower certainty and shows whether risk is assumed or not by notation of ***Risk/ Low Cert.*** if yes.
[2] See **Additional Characterization for Non-residential Buildings and Other Non-Food Uses** in **Section 5.2 Risk Description**.

1.5. Major Uncertainties and Critical Data Gaps

The toxicity and fate datasets are relatively complete, but some uncertainties still exist for toxicity estimates:

- Toxicity to terrestrial plants—the highest application rate tested in the available terrestrial plant toxicity studies did not adequately cover the maximum label rate and so toxicity could not be precluded from the ornamental shrub & vine use. Futhermore, numerous terrestrial plant damage incidents have been associated with acephate and methamidophos, although none were clearly caused by registered uses of acephate.
- The largest data gap was for pollinator toxicity data. No acute oral, chronic toxicity data or larval toxicity data were available. These represent significant uncertainties for the assessment of the impact of acephate on pollinators. The pollinator data gaps include:

  Tier I – laboratory based studies:
  - OECD TG 213 and Non-guideline studies: Honey bee adult acute and chronic oral toxicity studies (a protocol needs to be submitted for review prior to conducting the chronic study)
  - OECD TG 237 and Non-guideline studies: Honeybee larval acute and chronic oral toxicity studies (the protocol for the acute study is through OECD TG 237; protocol needs to be submitted for review prior to conducting the chronic study)

  Tier II & Tier III – field based studies:
  - Non-guideline special studies: Field trial measuring residues in pollen and nectar (protocol needs to be submitted for review prior to conducting study)
  - Non guideline special study (Tier II: Semi-field testing for pollinators) and OSCPP 850.3040 (Tier III: Field testing for pollinators): (both studies are conditionally required pending the results of the Tier I – laboratory based studies listed above. If studies are needed protocols for each study must be submitted for review prior to study initiation).

Other uncertainties include:

- Systemic plant uptake: as mentioned above, acephate is a systemic insecticide, and yet, as discussed in **Section 3.5**, both acephate and methamidophos are non-persistent; therefore, some uncertainty exists as whether acephate or methamidophos would persist long enough in plants to be present in nectar or pollen for pollinator exposure.

1.6. Extent of Risk

Based on risk estimates and incident data, acephate clearly is capable of adversely affecting non-target animals and possibly plants when exposed.

2. INTRODUCTION

Acephate (O, S-dimethyl acetylphosphoramidothioate; **Table 2**) is a systemic, organophosphate insecticide currently registered for use on a variety of field, fruit, and vegetable crops; in food handling establishments; on ornamental plants both in greenhouses and outdoors (including lawns, turf, and cut flowers); and in and around the home. Acephate was first registered in 1973 for ornamental uses and in 1974 for food uses (agricultural crops). Formulation types registered include wettable powders, soluble powders, soluble extruded pellets, granular, and liquid. Target pests include armyworms, aphids, beetles, bollworms, borers, budworms, cankerworms, crickets, cutworms, fire ants, fleas, grasshoppers, leafhoppers, loopers, mealy bugs, mites, moths, roaches, spiders, thrips, wasps, weevils, and whiteflies. Acephate rapidly degrades to methamidophos (see **Table 2**) which is also an insecticide but is no longer registered for use in the United States.

Table 2. Chemical Identification Information for Acephate and Methamidophos.

Acephate	
PC Code:	103301
CAS Number:	30560-19-1
CAS Name:	phosphoramidothioic acid, acetyl, O,S-dimethyl ester
IUPAC Name:	N-(methoxy-methylsulfanylphosphoryl)acetamide
SMILES Code:	O=C(NP(=O)(OC)SC)C
Molecular Formula:	$C_4H_{10}NO_3PS$
Molecular Mass:	183.17
Methamidophos	
PC Code:	101201
CAS Number:	10265-9-6
CAS Name:	phosphoramidothioic acid, O,S-dimethyl ester
IUPAC Name:	O,S-dimethylphosphoramidothioate
SMILES Code:	O=P(OC)(SC)N
Molecular Formula:	$C_2H_8NO_2PS$
Molecular Mass:	141.1 $g{\cdot}mol^{-1}$

2.1. Problem Formulation Update

This assessment is based on the preliminary problem formulation for the registration review of acephate (USEPA, 2009).[1] The preliminary problem formulation includes a discussion of potential stressors, conceptual models and tools used to estimate exposures to non-target organisms. The only modifications from the baseline information provided in the preliminary problem formulation are the inclusion of newly available fate and effects data and the use of updated methods (*e.g.*, recent model improvements) currently approved for use in ecological risk assessments. The purpose of this assessment is to evaluate the potential risks to non-target organisms from the registered uses of acephate. The focus is on species that are not Federally listed as threatened or endangered (referred to as 'listed'). For taxa where risks exceed

[1]DP Barcodes: 35704 and 354619, January 5, 2009. "Registration Review – Preliminary problem formulation for the Ecological Risk Assessment of Acephate," internal memorandeum to the Special Review and Reregistation Division.

designated levels of concern, specific determinations for listed species are considered uncertain at this time.

The ecosystems that are potentially at risk are those in close proximity to acephate use sites. These include agricultural or residential sites, fallow land, commercial or research greenhouses, shadehouses, and nurseries and the surrounding areas that may be exposed to acephate via spray drift and/or runoff. Organisms of concern include birds, mammals, reptiles, fish, and terrestrial and aquatic invertebrates, and amphibians, and to some extent terrestrial and aquatic plants.

The problem formulation (USEPA, 2009) identified data needs for anaerobic soil, aerobic aquatic metabolism and bird and aquatic plant toxicity. Since the 2009 problem formulation, a risk assessment was completed for listed San Francisco Bay species (USEPA, 2011a).[2] That assessment made determinations that acephate use in California is likely to adversely affect the assessed species and modify their habitats. Since that assessment, the requested data has been submitted and reviewed, including two new fate studies and six new toxicity studies. The new fate studies allow for more comprehensive characterization of the environmental fate, but did not change the results of the risk assessments. The new toxicity studies resulted in a more sensitive acute toxicity estimate for birds and more information on the toxicity of acephate and its major degradate, *i.e.*, methamidophos, to aquatic plants. Updated models[3] used include the recently released Surface Water Concentration Calculator (ver. 5.0) and updated versions of T-REX (ver. 1.5.2) and TerrPlant (ver. 1.2.2).

2.2. Use Characterization

The current labels for acephate represent the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis o f this assessment. The assessment of use information is critical to the selection of appropriate modeling scenarios and inputs.

The following use profile is based on the current, federally registered uses (Section 3 and 24c):

Food: Acephate is registered for use on beans, Brussels sprouts, cauliflower, celery, cotton, cranberries, lettuce, peanuts, peppermint, peppers (bell and non-bell), citrus, fruit trees, nut trees, soybeans, and spearmint.

Other Agriculture, Non -food: Acephate is also re gistered for use as seed treatment on cotton and peanuts (seed for planting), on non-bearing fruit trees, a variety of ornamentals, and on tobacco.

Residential: Acephate is registered for use in residential lawns on for the control of fire ants. It is also registered for outdoor use on trees, shrubs and ornamentals.

[2] http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/2011/acephate2/analysis.pdf
[3] http://www.epa.gov/pesticides/science/models_db.htm

Public Health: Acephate is registered for use in and around industrial, institutional and commercial buildings, including restaurants, food handling establishments, warehouses, stores, hotels, manufacturing plants, and ships for the control of roaches and fire ants.

Other Nonfood: Acephate is registered for use on sod, golf course turf, field borders, fence rows, roadsides, ditch banks, borrow pits, wasteland, and greenhouse and horticultural nursery floral and foliage plants.

Target pests include: Armyworms, aphids, beetles, bollworms, borers, budworms, cankerworms, crickets, cutworms, fire ants, fleas, grasshoppers, leafhoppers, loopers, mealybugs, mites, moths, roaches, spiders, thrips, wasps, we evils, whiteflies, and others (USEPA, 2006).

Formulation types: Wettable powder, soluble p owder, soluble extruded pellets, granular, and liquid. All forms, except for granular, are mixed with water prior to application and are applied in a liquid form.

Equipment for agriculture, greenhouse, nursery, and turf uses: Granular acephate can be applied by belly grinder, hand, tractor-drawn spreader, push-type spreader, and shaker can. Liquid acephate (formulated from soluble powders or soluble extruded pellets) may be applied by aircraft, airblast sprayer, backpack sprayer, chemigation, hydraulic sprayers, groundboom spray, handgun, high pressure sprayer, hopper box (seed treatment), low-pressure hand wand, slurry (seed treatment), sprinkler can, transplanting in water (tobacco), or by an aerosol generator (greenhouses).

Equipment for residential and public health uses (vector control): Residential applications can be made by aerosol can, backpack sprayer, hose-end sprayer, and low-pressure handwand. Residential granular applications can be made by shaker can or by hand. Residential soluble powder applications may be made by sprinkler can or compressed air sprayers.

***Method*:** Acephate may be applied on seed before planting, in-furrow at planting, or as a foliar spray, it may be applied to flower beds, plant beds, or as a transplant (tobacco) treatment. For use against fire ants it may be applied directly on their soil mound (drench and dry methods). Acephate is also used indoors as spot, crack and crevice, and ba it treatments.

2.3. Label Application Rates and Intervals

There are over 100 registered labels for acephate, with products ranging from 1.0% to 98.9% active ingredient (a.i.). Section 3 (nation-wide) and Section 24(c) (special local needs, or 'SLN') registered uses for acephate were reviewed, including the label maximum single application rate, maximum seasonal rate, number of applications allowed per year, the minimum time between treatments, and the application type (see Table 3). Letter codes before the crop entry in Table 3 are intended to group crops with similar use patterns for assessment purposes. Those with the same letter will be assessed together for the terrestrial risk assessment. If the code has letter followed by a number, then there will be separate aquatic assessments for each, as different scenarios were deemed appropriate for those crops within those groups.

Table 3. Maximum label use patterns by use site for the assessment from acephate use.

Crop	Max. App. Rate (lb acre^{-1})	Max Seasonal Rate (lb acre^{-1})	Number of Apps.	Application Intervals (days)	Application Method
T) alfalfa	0.97	1.95	2	NS	aerial, ground
X) almond, non-bearing[1]	0.97	NS	NS	7	aerial, ground
Y) apple, non-bearing	0.97	NS	NS	7	aerial, ground
Y) apricot, non-bearing	0.97	NS	NS	7	aerial, ground
H) beans, dry	1	2.07	NS	7	aerial, ground
H) beans, lima, dry	1	2.07	NS	7	aerial, ground
Z) Bermuda grass	0.99	NS	NS	7	aerial, ground
J) Brussels sprouts	1	2	NS	7	aerial, ground
J) cauliflower	1	2	NS	7	aerial, ground
K) celery	1	2	NS	3	aerial, ground
Y) cherry, non-bearing	1	2.07	NS	7	aerial, ground
D) Christmas trees	0.5	NS	NS	NS	aerial, ground
AA) citrus, non-bearing	4[2]	NS	NS	7	ground
V) citrus, non-bearing	1	NS	NS	7	aerial
AC) citrus, non-bearing, fire ants	0.0094 lb/mound	NS	NS	NS	mound drench
AC) commercial/industrial lawns	0.0094 lb/mound	NS	NS	NS	mound drench
Q) cotton (foliar)	1	4	NS	7	aerial, ground
A) cotton seed treatment	0.45 lb/100 lb seed	NS	NS	NA	seed treatment
Y) crabapple	0.25	NS	3	28	airblast
F) cranberry	1	1	NS	NA	aerial, ground, sprinkler irrigation
Y) deciduous fruit trees, non-bearing	0.97	NS	NS	7	aerial, ground
AB) golf course turf	4.77	NS	NS	7	ground
AC) golf course turf	0.009 lb/mound	NS	NS	NS	mound drench
U) grapes 1, non-bearing	0.73	NS	NS	NS	aerial, airblast
W) grapes 2, non-bearing	0.97	NS	NS	7	aerial, airblast
AC) household premises	0.0094 lb/mound	NS	NS	NS	mound treatment
Y) kiwi fruit, non-bearing	0.97	NS	NS	7	aerial, ground
P) lettuce, crisphead types	1	2	NS	7	aerial, ground
L) mint/peppermint/spearmint	1	2	NS	NS	aerial, ground
AC) non-crop areas	.009 lb/mound	NS	NS	NS	mound treatment
AG) non-residential building premises[3]	10.1	NS	NS	NS	perimeter spray
AC) ornamental trees/shrubs	0.002 gal/mound	NS	NS	NS	mound drench
Y) nursery stock[3]	261	NS	NS	7	container drench
AE) ornamental/shade trees[3]	21.8	NS	NS	NS	ground spray
AE) ornamental ground cover[3]	21.8	NS	NS	NS	ground spray

Crop	Max. App. Rate (lb acre^{-1})	Max Seasonal Rate (lb acre^{-1})	Number of Apps.	Application Intervals (days)	Application Method
AE) herbaceous ornamental plants[3]	21.8	NS	NS	NS	ground spray
AC) ornamental lawns	0.009 lb/mound	NS	NS	NS	mound treatment
AE) ornamental non-flowering plants[3]	21.8	NS	NS	NS	ground spray
AE) ornamental woody shrubs and vines	21.8	NS	NS	NS	ground spray
N) peanuts (foliar)	1	4	NS	7	aerial/ground spray
C) peanuts, seed treatment	0.2 lb	NA	NA	NA	seed treatment
Y) pear, non-bearing	0.97	NS	NS	7	aerial/ground
X) pecan, non-bearing	0.99	NS	NS	7 d	aerial/ground
M) pepper, bell	1	1.995	NS	7	aerial/ground
D) pepper, non-bell	0.5	1	NS	3	aerial/ground
X) pistachio, non-bearing	0.97	NS	NS	7	aerial/ground
Y) plum, non-bearing	0.97	NS	NS	7	aerial/ground
Y) prune, non-bearing	0.97	NS	NS	7	aerial/ground
AC) recreational area lawns	0.0094 lb/mound	NS	NS	NS	fire ant mound treatment
AC) residential lawns	0.0094 lb/mound	NS	NS	NS	fire ant mound treatment
S) rights-of-way	0.25	NS	NS	NS	aerial
AD) roses[3]	15.9	NS	NS	7	ground spray
AB) sod	4.77	NS	NS	7	ground spray
R) southern pine seed orchard	3/3.5[4]	NS	2	14	aerial/ground
G) soybeans	1	1.5	NS	7	aerial, ground
O) tobacco	1.12/0.75[5]	3.6	NS	7	ground
X) tree nut, non-bearing	0.97	NS	NS	NS	aerial/ground
X) walnut	0.97	NS	NS	7	aerial/ground
B) wasteland	0.248	NS	NS	NS	aerial/ground

1) Application interval is 3 d for applications < 0.5 lb·acre^{-1} and 7 d for application greater than 0.5 lb·acre^{-1}.
2) Use is limited to Florida
3) Label rate in lb of pesticide per volume of spray. Calculation of area based rate is described in the text.
4) The application rate for slash pine in southern pine seedling orchards is 3.5 lb·acre^{-1} by ground spray and 3 lb·acre^{-1} for an aerial spray.
5) the first application is higher at transplant in Tennessee only, all other applications are at 0.75 lb·acre^{-1}
NA – not applicable; NS – not specified; AN – as needed

The use patterns assessed for risk are in **Table 3**. As noted above, crops with similar use patterns have been grouped together witha specific crop chosen as a surrogate for the group When the neither a maximum seasonal application rate nor a maximum numbe r of applications per year was specified, 26 applications were assumed as this is the maximum number of applications per year that can be simulated with PRZM, the agricultural field component of the the Surface Water Calculator (SWCC, also see **Appendix A**). If no minimum application interval was specified, a 3-day application interval was assumed since, in most cases, this represents the minimum interval which would be used to reapply a chemical as it allows two days for scouting to determine efficacy and the application is made on the third day if application has not suppressed the pest. Note that for alfalfa, the label specifies a 2 -day application interval. Note also that these numbers of applications or minimum intervals are not expected to be used frequ ently, if ever, for acephate. However, at least for some uses (*e.g.* ornamentals) these conservative assumptions result in applications of acephate which exceed 20 lb·acre^{-1}.

In cases when both aerial applications as well as air blast or ground spray applications are allowed on the label, the aerial application was simulated as the off -site drift from aerial applications is greater. A discussion of application rates and surrogacy groups for some groups follows.

Table 4. Use Patterns for Aquatic Ecological Risk Assessment for Acephate.

Use	Application Rate (lb a.i./acre)	Number of applications[1]	Application Interval[1] (days)	Application Type
A) cotton seed treatment	0.06	1	NA	incorporated with seed
B) waste land	0.248	26	3	aerial
C) peanuts seed treatment	0.2	1	NA	at plant with seed
D) peppers, non-bell	0.5	2	3	aerial
E) Christmas trees	0.5	26	3	aerial
F) cranberry	1	1	NA	aerial
G) soybeans	1, 0.5	2	7	aerial
I) beans	1	2	7	aerial
J) cauliflower	1	2	7	aerial
K) celery	1	2	3	aerial
L) mint	1	2	3	aerial
M) peppers	1	2	7	aerial
N) peanuts	1	4	7	aerial
O) tobacco	1.12/0.75/0.23[2]	5	7	aerial
P) lettuce	1	2	7	aerial
Q) cotton	1	4	7	aerial
R) southern pine seed orchard	3/3.5	2	28	aerial/ground
S) rights-of-way	0.25	26	3	aerial
T) alfalfa	0.974	2	3	aerial
U) grapes 1	0.73	26	3	aerial
V) citrus 2	0.75	26	7	aerial
W) grapes 2	0.974	26	7	aerial
X) almonds, non-bearing	0.97	24	7	aerial
Y) apples, non-bearing	0.97	26	7	aerial
Z) Bermuda grass	0.99	26	7	aerial
AA) citrus 1	4	26	7	airblast
AB) sod farms	3	26	3	ground spray
AC) golf course turf	4.77	26	7	ground spray
AD) fire ants	6.84	26	3	ground spray
AE) roses	15.9	26	3	ground
AF) ornamentals	21.8	26	3	ground
AG) non-residential buildings	10.1	26	3	perimeter spray

[1] The largest number of applications with the shortest interval between applications is used whenever the label does not specify the number of applications or application interval.
[2] The first application is 1.12 lb·acre^{-1}, the next three are at 0.75 lb·acre^{-1} and the last application is .23 lb·acre^{-1} for a total of 3.6 lb·acre^{-1}, the seasonal maximum rate for tobacco.
[3] The application has been multiplied by a factor of 0.5 to reflect spot treatment use.
NA: not applicable

Alfalfa. This use is only for alfalfa grown for seed in California. Maximum applications rates are per year and not per cutting.

Beans. Acephate is registered for both dry and succulent bean crops including lima beans, green beans, wax beans, and common dry beans. Use on succulent green bea ns is only allowed when they are grown for seed. Note that soybeans are being modeled using a separate scenario.

Bermuda grass. This use is on a Special Local Needs registration for use in California only for Bermuda grass for seed production. While turf grass crops do not normally receive aerial applications, the label provided specific instructions of aerial applications to this crop, so aerial application was simulated.

Cauliflower. Cauliflower is being used as a surrogate for Brussels sprouts as they have the same use pattern and similar management practices with respect to pesticide use . For terrestrial assessments, cauliflower is also being used as a surrogate for celery and mint.

Cotton. The application rate for th e seed treatment use for cotton is based on an application rate per 100 lb of seed, specifically, 1.6 lb a.i./100 lb of seed. Based on a review of planting practices from the Biological and Economic Analysis Division (Becker and Ratnayake, 2011), the maximum planting rate for cotton is 18.9 pounds per acre. Based on this planting rate, the resulting application rate of acephate for this use is 0.06 lb $\cdot$acre^{-1}. For terrestrial assessments, cotton seed treatment and the foliar treatment are considered separately while for aquatic assessment; a single simulation combining both application practices to cotton was used.

Deciduous fruit trees. Apples serve as a surrogate crop for deciduous fruit trees including apricots, cherries, pears, plum, and prunes. Note that crabapples have use pattern specific to the crop of 0.25 lb$\cdot$acre^{-1}, however, they can also be treated under the non-bearing deciduous fruit tree use pattern at the same (higher) rate as other deciduous fruit trees and are not being considered separately in this assessment. The number of applications is limited to 25 at 7 day intervals by the length of the growing season.

Fire ants. Applications to control fire ants are made in a number of specific use sites including non-bearing citrus, commercial and industrial lawns, golf courses, household & domestic dwelling premises, ornamental trees and shrubs, ornamental lawns, recreational area lawns, and r esidential lawns. Use rates for these uses may be specified in mass per unit area or mass of pesticide per mound. The rates per mound are generally higher for serious fire ant infestations. For fire ants in polygynous colonies, mound densities can be as high as 1880 mounds per hectare or 760 mounds per acre (Vogt *et al.*, 2003). Since the highest application rate per mound is 0.009 lb a.i. per mound. The maximum application rate assessed for use on fire ants is 6 .84 lb$\cdot$acre^{-1}. This application rate is expected to be conservative the great majority of the time because it is based on the highest documented fire ant density in the United States.

Golf Course Turf. For the label with the maximum application rate to golf course turf, the general heading for golf course turf and sod farms restricts application to 4 lb$\cdot$acre^{-1} for golf courses and 3 lb$\cdot$acre^{-1} for sod farms. However, the specific instructions in the same section recommend 1.8 oz per thousand square feet of a 97% active ingredient product for control of cut worm, chinch bug, and fleas which is equivalent to 4.77 lb·acre^{-1}. This higher rate was used for the assessment of golf courses as the label is ambiguous about the maximum rate.

Lettuce. There are two lettuce use patterns, one for 'crisphead' lettuce types, and one for all other head lettuces. Both patterns have the same application rate but the crisphead use pattern allows five applications while only two applications are allowed for other head lettuces. Only the crisphead lettuce use pattern is being assessed because it has a higher yearly application rate.

Mint. Cauliflower is being used as a surrogate for mint in the terrestrial assessment as they have the same use patterns. Separate aquatic exposure assessments will be performed as the two use patterns are simulated with different scenarios.

Non-residential buildings. This is listed as 'Outdoor Wasp and Perimeter Spray' on labels. This is a perimeter treatment for control of *indoor* pests such as ants and cockroaches by treating the outdoor perimeter of the building. Instructions on most labels are to apply a band up to 3 feet high from the ground on the building and a band 6 feet wide in the soil at the base of the building. The maximum label rate for this use on any label is 1.164 ai oz per gallon, or 0.073 lb per gallon. A square 10,000 square foot building is 100 feet on each side. The total area of the building sprayed is 100 ft x 3 ft x 4 sides = 1200 ft^2 or 111.5 m^2. If we assume that 0.5 mm of spray is required to wet the side of the building, then .0558 m^3 or 14.7 gal of spray on the building. The area on the ground around the perimeter of the building is 100 ft x 6 ft x 4 sides + 6 ft x 6ft x 4 (for the corners) = 2544 ft^2 or 236.3 m^2. If 2 mm of spray is required to wet the soil and foliage in the spray zone then 0.47 m^3 of spray or 124.9 gal of spray is needed to cover the ground, or a total of 139.6 gal to treat a building, If each building is on a 1 acre lot, then we can estimate that there will be 10.1 lb·acre^{-1} of active ingredient applied. Note that the difference in spray depth to coat the building versus foliage is because there is typically 3 to 4 times the area of foliage relative the ground it is covering.

Nursery Stock. This use includes a soil drench for control of root weevils (Reg No. 1381 -238) with an application rate of 0.75 lb ai per 100 gallon of water for containerized nursery stock. If we assume the containers are circular, the closest packing fraction is 0.9069 or hectare of pots contains 9069 m^2 of surface area. It the pots are 15 cm deep, volume of the pots is 136 m^3. If we assume that the available water capacity is 25 percent of the pot volume, then it would take 340.1 m^3, or 8978 gallons to drench the pots in a hectare. At 0.75 lb of acephate per 100 gals, this is equivalent to 67.3 lb·ha^{-1} or 27.3 lb-ai·acre^{-1}. It is reasonable to assume that the pots cannot completely cover the surface as space between them is necessary for the care of the plant. If we assume half the surface is covered with plants and half is space between the rows, the application rate would be 13.6 lb·acre^{-1}. Note that many labels limit the application to 0.75 lb per acre for this use. This use pattern was not separately assessed, but would be included as an additional application to the ornamental use pattern discussed below. Including the application in the ornamentals assessment would increase the EECs above the level already assessed.

Nut trees. Pecans serve as a surrogate for nut tree crops in this assessment including almonds, pistachio and walnut. Only non-bearing nut trees can be treated with acephate. For terrestrial assessments, almonds are also serving as a surrogate for deciduous fruit tree crops including apples. The number of applications is limited to 24 at 7 day intervals by the length of the growing season.

Ornamentals. This use pattern includes ornamental trees, shade trees, ground covers, and non - flowering plants. Ornamental woody vines and shrubs have a higher use rate and are being assessed separately. The highest use rates for these use patterns were expressed in lb of active ingredient per 100 gal of spray. In order to use these rates in a risk assessment, an area-based application rate must be estimated. If it is assume d that a 2 mm depth of water is required to wet the grass, then 20,000 liters per hectare (0.002 m x 10,000 m^2/ha x 1000 L/m^3) or 2183 gal/acre are required to wet a lawn. With a maximum application rate for these use patterns of 1 lb per 100 gal, this is equivalent to 21.8 lb·$acre^{-1}$.

Peanuts. The application rate for the seed treatment use for peanuts is based on an application rate per 100 lb of seed, specifically, 0.197 lb a.i./100 of seed . Based on a review of planting practices from the Biological and Economic Analysis Division (Becker and Ratnayake, 2011), the maximum planting rate for peanuts is 228 pounds per acre . Based on this planting rate, the resulting application rate of acephate for this use is 0.45 lb·$acre^{-1}$.

Sod Farms. The general headi ng for golf course turf and sod farms restricts application to 4 lb-ai·$acre^{-1}$ for golf courses and 3 lb-ai·$acre^{-1}$ for sod farms. However, the specific instructions in the same section recommend 1.8 oz per thousand square feet of a 97% active ingredient pro duct for control of cut worm, chinch bug, and fleas which is equivalent to 4.77 lb·$acre^{-1}$. This higher rate was used for the assessment of golf courses as the label is ambiguous, but the rate of 3 lb·$acre^{-1}$ (2.91 lb-ai·$acre^{-1}$) was used for sod farms.

Tobacco. The first application of 1.12 lb·$acre^{-1}$ is only allowed in Tennessee and is made at transplant. It must be applied in 100 gal of water per acre so it will only be made with ground equipment. The last application was of 0.23 lb·$acre^{-1}$ so as to make a t otal of 3.6 lb·$acre^{-1}$ for the season.

Wasteland. This nebulous use pattern is grouped as non -crop area for the control of black grass bugs, grasshoppers and Mormon crickets. Since this could include abandoned parking lots, for example, it is being simulated using the impermeable surface scenario.

In addition to the uses listed above, there are other uses that are not being considered in this assessment (**Table 5**). Indoor uses have been excluded because no exposure to wildlife is expected. The applications to ships and boats is for the interior spaces of the vessels and is considered an indoor use. The use on garbage cans is an outdoor use, but no sound method for estimating exposure from this routecurrently exists. While effects on wildlife cannot be precluded, the extent of the use pattern is small and overall risk limited.

The tree injection uses were not considered for this assessment. While methods for assessing these uses exist, they are highly uncertain. In addition, the rou te of exposure would be by consuming the foliage, so these insects are then the targets of the pesticide, and not 'non-target' wildlife. Since both acephate and methamidophos degrade rapidly, it is unlikely that any significant pesticide will be present after leaf fall and degradation, so exposure through runoff into water is not expected to be significant.

Table 5. Acephate use sites for which no risk assessment will be performed.

Use Site	Justification
bathroom premises	indoor use
commercial/institutional/industrial premises	indoor use
commercial storage/premises	indoor use
Christmas trees	tree injection
conifer release	tree injection
crepe myrtle	paint on slurry
eating establishments	indoor use
food stores/markets/supermarkets	indoor use
forest nursery plantings	tree injection
forest trees	tree injection
hospital/medical institutions	indoor use
household/domestic dwelling	indoor use
meat processing plant/premises	indoor use/crack and crevice treatment
non-agricultural outdoor buildings	bee nests only; very limited exposure
greenhouse container ornamentals	indoor use
poultry processing plant premises	indoor use
recreational areas	tree injection
garbage cans	minimal outdoor exposure & no assessment method
indoor refuse containers	indoor use
seed orchard trees	tree injection
shelter belt plantings	tree injection
ships and boats	no outdoor exposure

Most acephate product labels specify application rates on a per crop cycle basis (not on a per year basis). Informat ion from the Agency's Biological and Economic Analysis Division (BEAD) indicates that many crops can be grown more than one time/year (USEPA , 2007). Since standard PRZM scenarios only consist of one crop per year, applications to only one crop per year were modeled. The crops that may be grown multiple times in a calendar year that can be treated by acephate include cauliflower, celery, and lettuce. The cropping seasons range between two and four cycles per year. If acephate is applied for multiple croppin g cycles within a year, EECs (estimated environmental exposures) presented in this assessment may under -predict exposures. For pesticides with short environmental persistence like acephate, contributions t o the estimated risk from more than one cropping season per year on a single field is s mall. For all other labeled uses, it was assumed that a maximum seasonal application specified on the label was equivalent to a maximum annual application.

According to the United States Geological Survey's (USGS) national pesticide usage data (based on information from 1999 to 2004), an average of 2.46 million lbs of acephate is applied nationally to agricultural use sites in the U.S. (non -agricultural uses are not included) (**Figure 1**). Of this, about 65% of the total usage was on cotton followed by 14% on tobacco and 7% on soybeans.

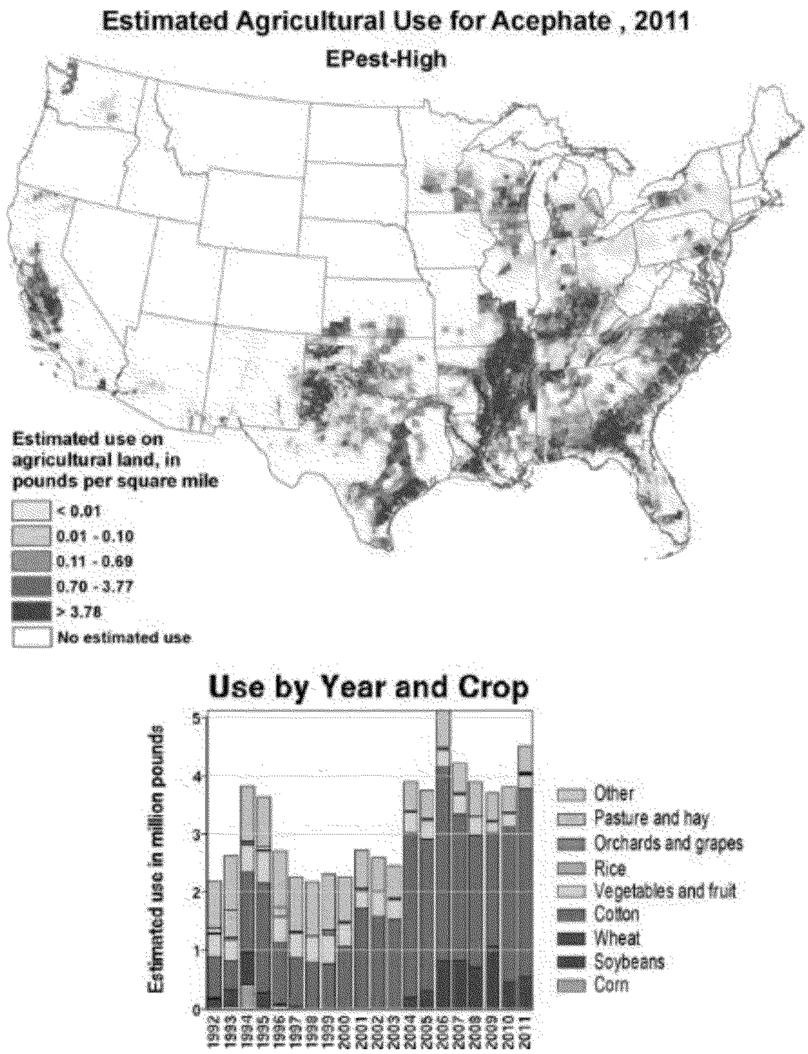


Figure 1. Acephate Use in Total Pounds per County.
(from http://water.usgs.gov/nawqa/pnsp/usage/maps/compound_listing.php)[4]

BEAD provides an analysis of both national- and county-level usage information (USEPA, 2011b) using state -level usage data obtained from USDA -NASS[5], GFK[6], and the California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database[7] CDPR PUR

[4] The pesticide use maps available from this site show the average annual pesticide use intensity expressed as average weight (in pounds) of a pesticide applied to each square mile of agricultural land in a county. The area of each map is based on state-level estimates of pesticide use rates for individual crops that were compiled by the CropLife Foundation, Crop Protection Research Institute based on information collected during 1999 through 2011 and on 2002 Census of Agriculture county crop acreage. The maps do not represent a specific year, but rather show typical use patterns over the five year period 1999 through 2011.
[5] United States Depart of Agriculture (USDA), National Agricultural Statistics Service (NASS) Chemical Use Reports provide summary pesticide usage statistics for select agricultural use sites by chemical, crop and state. See http://www.pestmanagement.info/nass/app_usage.cfm.
[6] http://www.gfk.com/en-us, the full dataset is not provided due to its proprietary nature
[7] The California Department of Pesticide Regulation's Pesticide Use Reporting database provides a census of pesticide applications in the state. See http://www.cdpr.ca.gov/docs/pur/purmain.htm.

is considered a more comprehensive source of usage data than USDA-NASS. There is a generally decreasing trend in use in the California data 1999 to 2009.

3. EXPOSURE ANALYSIS

3.1. Environmental Fate Properties

Acephate degrades rapidly in the environment by microbial metabolism with a mean aerobic soil metabolism half-life of 1.5 d It degraded somewhat more slowly in a single anaerobic aquatic metabolism study ($t_{1/2}$= 6.6 d). Acephate predomi nantly degrades to methamidophos in aerobic soils with conversion efficienciesranging from 10 to 100%. Anaerobic aquatic metabolism is also rapid ($T_{1/2}$ = 6.6 d) with a maximum of 35% of the applied aceph ate converted to methamidophos at 3 d.

Table 6 lists the physical-chemical and fate properties of acephate. Hydrolysis of acephate is slow at pH 5 ($T_{1/2}$ = 325 d) and the rate decreases with increasing pH (($T_{1/2}$ @ pH 9 = 618 d). There is no evidence of degradation by p hotolysis. Both acephate and methamidophos are considered highly mobile with K_{oc}s of 2.7 $L \cdot kg^{-1}$ and 0.9 $L \cdot kg^{-1}$, respectively. In spite of the high mobility, neither acephate nor methamidophos is expecte d to be a concern in drinking water because they degrade rapidly in the soil except perhaps for the highest application rates when multiple applicaitions are made per season. While methamidophos would be considered semivolatile with a vapor pressure in the range 10^{-5} torr, neither acephate nor methamidophos is expected volatilize because they are so soluble in water(~815 $g \cdot L^{-1}$ and 200 $g \cdot L^{-1}$ for acephate and methamidophos respectively) , resulting in a very low Henry's Law constants, 5.1×10^{-13} $atm \cdot m^3 \cdot mole^{-1}$ for acephate and 1.62×10^{-11} $atm \cdot m^3 \cdot mol^{-1}$ for methamidophos.

Identified degradates are in **Table 7** . Other than CO_2, the only major degradates are methamidophos (aerobic soil metabolism), DMPT (O, S-dimethyl phosphorothioate), OMAP (O-methyl-N-acetylphosphoroamidothioate), and methyl disulfide by hydrolysis. Acephate is not persistent in anaerobic clay sediment: creek water systems in the laboratory, with a half-life of 6.6 days. The major degradates under anaerobic conditions were carbon di oxide and methane, comprising >60% of the applied acephate after 20 days of anaerobic incubation. No other anaerobic degradates were present at >10% during the incubation. There are no acceptable data for the aerobic aquatic metabolism of acephate.

Acephate is very soluble (801-835g/L) and highly mobile with an organic carbon partition coefficient (K_{oc}) of 2.7 $L \cdot kg^{-1}$ in the laboratory. Only one K_{oc} value is available, because acephate was adsorbed in only one of the five soils (a clay loam) used in the b atch equilibrium studies. Although acephate is expected to be mobile, because the compound is not persistent under aerobic conditions, very little acephate is expected to leach to groundwater. If any acephate does reach ground water, it would not be expected to persist, due to its short anaerobic half-life.

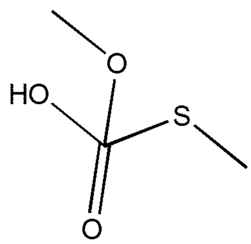
Table 6. Physicochemical and Fate Properties of Acephate.

Fate Property	Value	Source
Molecular Weight	183.16 g/mol	calculated
Henry's Law constant	5.1 X 10^{-13} atm-m^3/mole	Calculated from vapor pressure and solubility
Vapor Pressure	1.7 X 10^{-6} torr at 24°C 3.0 X 10^{-7} torr (gas saturation method)	MRID 40390601 MRID 40645901
Aqueous Solubility	801 g/L to 835 g·L^{-1}	MRID 40390601
Aqueous Photolysis	no evidence of degradatioin	MRID 41081603
Aerobic Soil Metabolism	Clarksburg, CA clay: 1.80 d Kettleman City, CA loam: 0.31 d Fresno, CA loam: 3.73 d Ocoee loamy sand: 1.70 d Mt. Holly sandy clay loam: 1.48 d Norwalk silty clay loam: 1.44 d Greenville clay 1.48 d Ocoee muck: 11.2 d mean: 1.49 d	MRID 00014991
Hydrolysis	325 days at pH 5 169 days at pH 7 18 days at pH 9	MRID 41081604
Anaerobic Aquatic Metabolism	6.6 days	MRID 43971601
K_{OC}	2.7 L·kg^{-1}	MRID 40504811

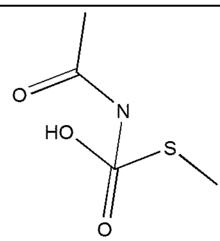
Field studies conducted in Mississippi (tobacco on a silt loam soil), California (bell peppers on a silt loam soil), Florida (cauliflower on a sand soil) and Iowa (soybeans on a loam soil) produced dissipation half-lives of 2 days or less with no detections of ac ephate below a depth of 50 cm. Laboratory studies showed that bioaccumulation of acephate in bluegill sunfish (*Lepomis macrochirus*) was insignificant. A maximum bioaccumulation factor of 10x occurred after 14 days' exposure to acephate at 0.007 and 0.7 ppm.

Table 7. Maximum degradates formation amounts found in acephate degradation studies and the time of occurrence.

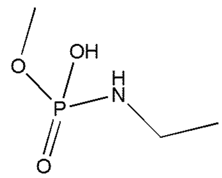
Degradate	methamidophos	DMPT (RE-18421)	SMPT (RE-17245)	OMAP (RE-18420)	carbon dioxide	methyl disulfide
Hydrolysis pH 5	-	1.4% @ 17 d	6.3% @ 31 d	-	-	-
Hydrolyis pH 7	< 2.5%	4.4% @ 30 d	5.5% @ 31 d	-	-	0.8% @ 31d
Hydrolysis pH 9	< 2.5%	47% @ 23 d	-	29.1@ 23 d	-	
aerobic soil	23% @ 2 d	ND			86% @ 6 d	
anaerobic soil	24% @ 3 d	ND			26% @ 6 d	
anaer. aquatic	5.0 % @ 7 d	< 2.9% @ 7 d[1]	<2.9% @ 7 d[1]			
1) Only the sum of DMPT and SMPT was reported in the anaerobic aquatic metabolism study.						



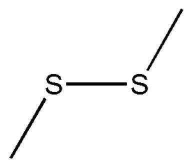
O,S-dimethylphosphorothioate (DMPT)



S-methyl-N-acetylphosphoroamidothioate (SMPT)



O-methyl-N-acetylphosphoroamidothioate (OMAP)



dimethyl disulfide

Figure 2. Structures of acephate degradates.

Batch equilibrium studies using acephate and methamidophos were conducted using four soils ranging in texture from sand to clay loam. In three of the soils, acephate and methamidophos were not a dsorbed in sufficient quantities to permit the calculation of Freundlich adsorption coefficients (Freundlich K_{ads}). For the clay loam soil, the reported adsorption values for parent acephate and its degradate, methamidophos, are listed in the following table:

Table 8. Adsorption Values for Acephate and Methamidophos

Soil	pH	CEC (meq/100g)	%clay	%organic matter	Acephate			Methamidophos		
					K_{ads}	1/n	r^2	K_{ads}	1/n	r^2
Clay loam	5.8	20.2	32	3.3	0.090	1.06	0.96	0.029	0.64	0.93

Calculated K_{oc} for acephate and methamidophos in this clay loam soil were 2.7 and 0.9, respectively. Because of the minimal adsorption of the chemicals in the adsorption phase of the study, it was not possible to determine desorption values in the soils. Based on the values listed above, it appears that acephate and methamidophos are highly mobile in soils.

Based on acceptable and supplemental data, methamidophos is not persistent in aerobic environments, but may be more persistent in anaerobic aquatic environments where it will be associated with the aqueous phase. A summary of the environmental fate properties of methamidophos is found in **Table 9** below.

Table 9. Physical-chemical and Fate Properties of Methamidophos.

Fate Property	Value	Source
Molecular Weight	141.2 g /mol	Calculated
Henry's Law constant	1.62×10^{-11} atm m^3 /mol	MRID 43661003
Vapor Pressure	1.73×10^{-5} torr	MRID 43661003
Aqueous Solubility	200 $g \cdot L^{-1}$	MRID 43661003
Aqueous Photolysis	200 days	MRID 00150610
Soil Photolysis	no significant degradation	MRID 46655801
Aerobic Soil Metabolism	14 hours	MRID 41372201
Hydrolysis	309 days at pH 5 27 days at pH 7 3 days at pH 9	MRID 00150609
Aerobic Aquatic Metabolism (water column)	No Data	Not Applicable
Anaerobic Aquatic Metabolism (benthic)	19.4 days	MRID 46934002
K_{OC}	0.9 $L \cdot kg^{-1}$	MRID 40504811

Similar to acephate, aerobic soil metabolism is the main degradation process for methamidophos. Methamidophos degraded with a calculated half-life of 14 hours in a sandy loam soil producing the intermediate degradate S-methyl phosphoramidothioate, which increased to 27% of the applied at 2 days but was not detected 5 d after application. (MRID 41372201). Supplemental information also identifies O,S-dimethyl phosphorothioate (DMPT), but the amount was not identified (MRID 00014076) In sterile aqueous solutions, methamidophos photodegrades with a half-life greater than 200 days (MRID 00150610) and there is no evidence of hydrolysis at acid pHs. Hydrolysis degradates at neutral and alkaline pH values include: O-*des*-methyl, DMPT, and the volatile degradate dimethyl disulfide.

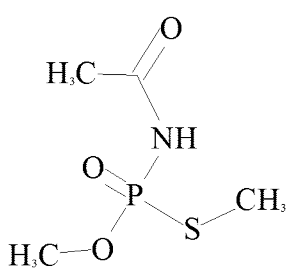
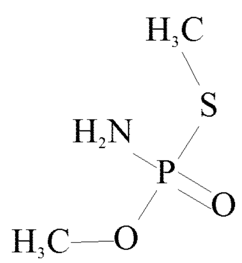
Supplemental information, provided from a laboratory pond water systems study, showed that methamidophos degraded in anaerobic sandy loam sediment with a DT_{50} (degradation time in which 50% degrades) of 41 days (MRID 46934002). The observed major degradates in the same study were DMPT and O-*des*-methyl methamidophos, but their persistence could not be determined due to incomplete material balances after 3 months of anaerobic incubation. Radiolabeled residues were distributed between the water and sediment fractions with the majority of residues observed in the water phase in a ratio of approximately 10 to 1. This study was repeated with silty clay sediment and depicted the following results: DT_{50} 7-14 days, and DT_{90} 58-93 days; the calculated half-life was 19.4 days. However, due to the loss of methane the mass accounted for was incomplete. Therefore, in order to use the calculated half-life from the anaerobic aquatic study (MRID 46934002) for future assessments, it is assumed that the missing mass was methane that had escaped the system due to volatilization and an inadequate ability to capture it. There are no acceptable data for the aerobic aquatic metabolism of methamidophos.

Field dissipation of m ethamidophos was conducted under U.S. field conditions in four replicate bare plots of loamy sand soil from Washington. In this study, the dissipation of methamidophos was rapid, yielding a half-life of 0.49 days in soil. No major transformation products were detected. In the 0-15 centimeter (cm) soil layer, two minor transformation products were identified: S-methyl phosphoramidothioate (O-*des*-methyl methamidophos) was a maximum average of 27.1 ppb and DMPT was a maximum average of 14.3 ppb each at day zero. In the 0-15 cm soil layer, no transformation products were detected after 1 day. In the 15-30 cm soil layer, dimethyl phosphorothiate was detected once at 3.7 ppb at 3 days (single replicate). No transformation products were detected in the 30-46 cm soil layer. The average measured time zero concentration was 332 parts per billion (ppb).

Laboratory studies showed that bioaccumulation of methamidophos in largemouth bass (*Micropterus salmoides*) was insignificant; the maximum bioconcentration factor of 0.09 in whole fish occurred on day 28 and decreased to <0.014 ppm in the fish (quantification limit) after one day depuration.

Potential transport mechanisms include pesticide surface water runoff, and spray drift. Methamidophos is very soluble (>200 grams per liter (g/L) and highly mobile (K_{oc} = 0.9)). The methamidophos degradate DMPT is also very mobile (K_{oc} = 1.6); no data are available for O-*des*-methyl methamidophos, but it is expected to have similar mobility as its parent compound. Because methamidophos and its degradates are not persistent under aerobic conditions, little methamidophos residue is expected to leach to groundwater. If any methamidophos residues did reach ground water, these residues may persist based on an observed anaerobic aquatic DT_{50} of 41 days for methamidophos and undetermined persistence for DMPT and O-*des*-methyl methamidophos. Volatilization from soil or water is not expected to be a major route of dissipation for methamidophos because of its rapid metabolism in soil and its calculated Henry's law constant (1.6×10^{-11} atm-m^3/mole). The chemical structures for acephate and methamidphos are depicted in **Table 10**.

Table 10. Chemical structures of acephate and its degradate methamidaphos.

Acephate	**Methamidophos**
	

3.2. Environmental Transport Mechanisms

Potential transport mechanisms include pesticide surface water runoff, spray drift, and secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. Because neither acephate nor methamidophos bind strongly to sediment, this route is not expected to be significant. Based on the vapor pressure of acephate and its calculated Henry's Law constant, it is not expected that volatilization will be a significant route of dissipation for acephate. Surface water runoff and spray drift are expected to be the major routes of exposure for acephate.

3.3. Monitoring in Aquatic Resources

There is very little useful water monitoring data for acephate, due to its non-persistent nature. Acephate or methamidophos were not analyzed forin the California surface water database or in the U.S. Geological Survey North American Water Quality Assessment (USGS NAWQA) surface water monitoring program. The 6 Organophosphate (OP) Drinking Water Monitoring Study (MRID 45526201) included acephate and methamidophos, but cross-contamination of samples during the analysis and changes in the analytical protocol during the study rendered the data from these two compounds unusable for these two compounds (DP Barcode D279614).

In July and August of 2002, the California Air Resources Board (CARB) conducted ambient air monitoring for acephate and methamidophos in highly populated areas of Fresno County (CARB, 2003). Although neither acephate nor methamidiphos are expected to volatilize appreciably, acephate was detected in seven out of 210 samples but measurements were below the limit of quantitation (LOQ) of 2.2 ng·m^{3} in six of these. There were measurements of methamidophos above the LOQ (0.86 ng·m^{3}) in 12 and detections below the LOQ in seven of 210 samples; however, at that time methamidophos was used as an insecticide in the area so it is not possible to discern whether the methamidophos detected was from methamidophos applications or as a degradate from acephate applications.

Due to the lack of substantial monitoring data, this assessment will be based on modeled concentrations as described in **Section 3.4**.

3.4. Aquatic Exposure Assessment

Conceptual Model of Exposure

Aquatic exposure is estimated with the Surface Water Calculator (SWCC) version 1.106 (Fry *et al.,* 2014). SWCC is a shell for PRZM 5, which simulates processes in the field and VWMM, the Variable Volume Water Body Model, which simulates processes in the water body. Screening-level EECs are produced using the standard farm pond of 20,000 cubic meters in volume. Watersheds where acephate is used are assumed to have 100% cropped area according to current standard methods.

Standard assumptions of 6.2% spray drift for ground application, 4.2% spray drift for air blast applications, and 12.5% drift for aerial application are used. These represent the drift using standard application practice assumptions (½-swath downwind offset, fine to medium spray quality, windspeed less than 10 mph, and spray boom 75% of wing span, no spray during temperature inversions, and an application height less than 10 ft for aerial). The initial condition of the agricultural field (PRZM variable INICROP) was set to "fallow ," the default value for all scenarios.

Use sites and the scenarios used to represent them are given in **Table 11Table 11**. Scenarios were chosen in accordance with current guidance for scenario selection[8]. In cases where specific information for a crop was available, a more appropriate date was selected.A justification for the scenario selection and any use specific rationales for application da te selections are provided below.

Table 11. PWC Scenario Assignments and First Application Dates for the Acephate Uses Simulated for the Drinking Water Exposure Assessment.

Crop group	Scenario	First Application Date
A & Q) cotton	MSCottonSTD	14 d before emergence
B) wasteland	CAImperviousRLF*	July 1
C) peanut	NCpeanutSTD	May 2, July 1
D & M) pepper, bell & non-bell	FLpeppersSTD	Oct 15
E) Christmas trees	GAPecanSTD	May 1
G) soybeans	MSsoybeanSTD	July 1
I) beans	MIbeansSTD	July 1
J) cauliflower	FLcabbageSTD	July 1
K) celery	CARowCropRLF_V2	Feb 1
L) mint	ORMintSTD	April 15
O) tobacco	NCtobacco	June 1
P) lettuce	CALettuceSTD	Feb 1
R) southern pine orchard seedlings	GAPecanSTD	May 1
S) rights-of-way	FLTurf	July 1
T) alfalfa	MNalfalfaOP	June 1
U & W) grapes	NYGrapeSTD	July 1
V & AA) citrus	FLCitrusSTD	July 1
X) tree nuts, non-bearing	GAPecanSTD	April 21
Y) apples, non-bearing	GAPeachSTD	March 15
Z) Bermuda grass	FLTurfSTD	July 1
AB) sod farms	FLTurfSTD	May 1
AC) golf course turf	FLTurfSTD	June 1
AD) fire ants	FLTurfSTD	June 1
AE) roses	FLNurserySTD_V2	May 1
AF) ornamentals	FLNurserySTD_V2	May 1
AG) non-residential buildings	FLTurfSTD	June 1

NA = not applicable

The general conceptual model of exposure for this assessment uses a standard pond of 20,000 m^3 with 10 ha watershed all planted to the specified crops and treated with the pesticide. The standard pond has no outflow, water is lost only through evaporation. This watershed geometry is intended to represent a group of vulnerable water bodies that occur near the tops of watersheds, and represents ponds directly but also serves a surrogate for wetlands, bogs, vernal

[8] http://www.epa.gov/oppefed1/models/water/przm_gw/wqtt_przm_gw_scenario_guidance.htm

pools, playa lakes, prairie potholes, headwater streams, and other small water bodies. Considerations for specific scenarios are described below.

Application dates were chosen to represent a date when application may actually occur and when rainfall events were likely, usually during the summer. Seed treatment application s were made at planting, 14 d before emergence. In general, a first application date of July 1 was selected as it represents the middle of the growing season in most of the United States. In cases where specific information for a crop was available, a more appropriate date was seleted. A justification for the scenario selection and any use specific rationales for application date selections are provided below.

Apples (non-bearing deciduous fruit trees). The first application date represents 2 weeks after leaf out.

Almonds (non-bearing nut trees). The first application represents 2 weeks after leaf out.

Citrus (Groups I & J): The use pattern that would produce the greatest EECs for citrus could not be determined from the label and was modeled two ways: with applications of 4 lb acre^{-1} applied by ground spray and 0.75 lb acre^{-1} applied aerially. The first use pattern gave the highest EECs.

Cranberries. Cranberries are flooded near harvest and for frost control in the fall before harvest. Cranberries have at least a 75 d pre-harvest interval for application. Given the rapid aerobic soil degradation of both acephate (1.5 d) and methomidophos (0.58 d), no measureable residues should remain when flood waters are released.

Mint. An application date of April 15 was chosen as it is early in the growing season for the scenario and when acephate is applied to control pests which occur in the region. Rainfall is likely to be higher at this time than later in the spring and summer.

Fire ants. The crop application method was set to 'broadcast' (PRZM variable CAM = 1) for this use to simulate application to the soil surface.

Cotton. The application date for the seed treatment was at planting on April 15. The crop application method was set to incorporate at a specific depth as with the planted seed. (PRZM variable CAM = 8). The incorporation depth was 0.5 inches.

Peanuts. The seed treatment use for peanuts was not simulated because the seeds are planted at 5 cm below the surface extraction zone (4 cm) and consequently there will be no runoff and hence no aquatic exposure from this use.

Wasteland. The CAImpervious scenario was used with weather from Daytona Beach, Florida to simulate application over very poorly draining wasteland such as an abandoned parking lot.

Chemical Inputs

The appropriate SWCC input parameters were selected from the environmental fate data submitted by the registrant (**Appendix B**) and in accordance with US EPA -OPP EFED water model parameter selection guidelines (Guidance for Selecting Inp ut Parameters in Modeling the Environmental Fate and Transport of Pesticides, Version 2.3, February 28, 2002). Based on previous assessments, the risks in aquatic resources from acephate applications are greater for the degradate methamidophos than the parent acephate, so only methamidophos was simulated for this assessment. Exposures based on methamidophos were calculated by applying a correction factor: 0.77 for the molecular weight difference (141.13/183.16 = 0.77). The total toxic residue approach was n ot used for methamidophos because it is known to be more toxic than acephate, so the assumption of equal toxicity needed for that approach is not valid.

The chemistry parameters for simulating methamidophos are in **Table 12**. Since no studies of aerobic aquatic metabolism are available the aerobic aquatic metabolism input parameter is estimated as twice the aerob ic soil metabolism value, or 3.5 d. Foliar degradation half-life for the aquatic exposure assessment were the same as those from the terrestrial exposure assessment, *i.e.*, 6.5 d for methamidophos, based on Willis and McDowell (1987) (see **Section 3.5**).

Table 12. Summary of Methamidophos Environmental Fate Data Used for Aquatic Exposure Inputs for SWCC Aquatic Species Assessment.[1]

Property	Surface Water Modeling Parameter Value	Source
Molecular Wt	141.13 $g{\cdot}mol^{-1}$	calculated
Aqueous Solubility	200,000 mg L^{-1}	MRID 43661003
Vapor pressure	1.73×10^{-5} torr	MRID 43661003
Henry's Law Constant	5.1×10^{-13} $atm{\cdot}m^3{\cdot}mol^{-1}$	calculated
Hydrolysis $T_{1/2}$	pH 5: 309 d pH 7: 27 d pH 9: 3 d	MRID 00150609
Aqueous Photolysis $T_{1/2}$	200 d	MRID 00150610
Aerobic Soil Metabolism $T_{1/2}$	1.75 d	MRID 41372201 3x single value
Aerobic Aquatic Metabolism $T_{1/2}$	3.5	2x aerobic soil
Anaerobic Aquatic Metabolism $T_{1/2}$	58.2 d	MRID 46934002
Foliar Degradation Rate	6.5 d^{-1}	see text
Foliar Washoff Rate	0.5 cm^{-1}	default
K_{oc}	0.9 $l{\cdot}kg^{-1}$	MRID 40504811

[1] Inputs determined in accordance with EFED "*Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides. Version 2.1*" dated October 22, 2009. Also see **Appendix A**.

Aquatic EEC Results

Table 13 presents the results of theSWCC modeling. Values range from 0 for the cranberry use to 2530 $\mu g \cdot L^{-1}$ for the perimeter use around buildings. Generally, the highest EECs are associated with the use patterns which were expressed as lb of product per 100 gal of spray and which have unlimited number of applications per year and no minimum application interval.

Table 13. One-in-ten-year Methamidophos EECs for Aquatic Environments from the Application of Acephate Uses.

Crop Group	Peak (µg/L)	21 Day EEC (µg/L)	60 Day EEC (µg/L)
A & Q) cotton	32.6	8.84	3.77
B) wasteland	37.5	14.0	9.56
C & N) peanuts, seed treatment	17.1	5.97	2.81
D) peppers, non-bell	17.4	3.97	1.42
E) Christmas trees	77.7	32.0	21.5
F) cranberry	0	0	0
G) soybeans	10.8	4.51	1.65
I) beans	15.1	6.21	2.38
J) cauliflower	37.5	8.21	2.89
K) celery	10.1	5.46	2.29
L) mint	9.00	4.37	2.10
M) peppers	29.3	0.438	0.339
O) tobacco	11.2	3.83	1.58
P) lettuce	16.7	8.48	3.38
R) southern pine orchard seedlings	47.5	9.21	4.33
S) rights-of-way	3.02	1.33	1.08
T) alfalfa	13.0	4.32	1.57
U) grapes 1	31.0	14.0	11.0
V) citrus 2	38.1	11.7	7.09
W) grapes 2	30.6	18.2	12.7
X) almonds, non-bearing	42.1	11.1	6.62
Y) apples, non-bearing	15.7	7.87	6.57
Z) Bermuda grass	16.3	7.00	5.35
AA) citrus 1	200	56.3	29.5
AB) sod farms	36.2	15.9	12.9
AC) golf courses	89.2	29.6	18.8
AD) fire ants	82.7	36.3	29.4
AE) roses	971	285	180
AF) ornamentals	1730	510	327
AG) non-residential buidlings	141	62.1	50.3

3.5. Terrestrial Exposures

Direct Deposition onto Food Items (located on treated field)

T-REX (Version 1.5.2) was used to calculate dietary and dose-based EECs of acephate and methamidophos for birds (including terrestrial-phase amphibians and reptiles), mammals, and terrestrial invertebrates. T-REX simulates a 1-year time period. For this assessment, spray and granular applications of acephate were considered. Terrestrial EECs were derived for the uses previously summarized in Table 3**Table 4**. Crops with similar use patterns (*i.e.*, application rates/intervals) were grouped together with one crop chosen as a surrogate for the group for the purpose of data presentation. Exposure estimates generated using T-REX were used to estimate risk associated with exposure to acephate and methamidophos. For methamidophos 100% of the applied acephate is assumed to degrade to methamidophos. While the amount of methamidophos detected in soil metabolism studies reached only 23% of the total applied acephate at any given time point, this number does not accurately represent the total amount of acephate that is cumulatively converted to methamidophos. As acephate degrades to methamidophos over time, methamidophos subsequently degrades to its transformation products, limiting the amount that is measured in a degradation study at one time point. Exposures for methamidophos were calculated by applying a correction factor: 0.77 for the molecular weight difference (141.13/183.16 = 0.77).

Terrestrial EECs for foliar formulations of acephate were derived for the uses summarized in Table 3**Table 4**. Use-specific input values, including number of applications, application rate, foliar half-life and application interval are provided in Table 3**Table 14**. These inputs represent the lowest, highest, and two mid-range application scenarios for acephate. These uses were chosen to illustrate the effects of acephate and methamidophos on terrestrial species over the full range of uses while minimizing redundancy in the results. Because of the high toxicity of acephate and methamidophos to terrestrial organisms, expanding these tables to include all uses would not add useful information in the context of this assessment. These uses were similar to those used in the San Francisco Bay Assessment (USEPA, 2011a), with the exception of updates made to the use table and adding back four uses that had been excluded from that assessment because the uses were not permitted in California; these uses included tobacco, soybean, cranberry and southern pine seed orchard uses. Note that the non-residential building perimeter use had a higher lb a.i./A application rate than ornamentals. However, because this was a perimeter/spot treatment (this also applies to the recreational lawn use, not shown in table) the exposure is less certain. The non-residential building use now has a lower maximum application rate of 10.1 lb a.i./A (see **Table 4**); this rate was not modeled in T-REX for this assessment but falls between the rates of citrus and ornamentals. Even though it is approximately half of the rate for ornamentals, but the exposure is characterized as having less certainty because being a spot-treatment, the size of the treated area and corresponding likelihood of an animal obtaining all of its diet from that area is uncertain.

The default half-life of 35 days in the T-REX model was not believed to be reasonable for a non-persistent pesticides like acephate or methamidaphos. Willis and McDowell (1987) list eight foliar dissipation values for acephate, five of which were for dislodgeable residues (range 0.7 to 8.2 days), and three of which were for total residues (range 2.8 to 3.5 days). Normally, total residue values would be used for acephate, since it has a low K_{OC} and is taken up through the roots (*i.e.*, it is systemically distributed through the plant). This rule was applied due to the assumption that residues will be higher and more persistent when the pesticide is taken up into the plant, rather than remaining on the surface of the foliage (which is measured by dislodgeable residue). Of the eight values, the one for California lemons was longest (95th percentile), and therefore most conservative, of 8.2 days was selected as the input to T-REX. Similarly, the longest (95th percentile) foliar dissipation half-life reported for methamidophos was 6.5 days, which was used in T-REX modeling (Willis & McDowell, 1987).

Table 14. Use-specific Input Parameters for Estimating Exposure in T-REX for Foliar Applications of Acephate Based on Maximum Labeled Rates and Minimum Retreatment Intervals.

Use (Application method)	Application Rate (lbs a.i./A)		Number of Applications	Application Interval	Foliar Dissipation Half-Life	
	Acephate	Methami-dophos			Acephate	Methami-dophos
Peppers, non-bell (aerial)	0.5	0.4	2	3	8.2 days	6.5 days
Celery/mint (aerial)	1.0	0.8	2	3	8.2 days	6.5 days
Citrus 1 (airblast)	4.0	3.1	26	7	8.2 days	6.5 days
Ornamentals (ground)	21.8	16.8	26	3	8.2 days	6.5 days

NA = Not applicable

Organisms consume a variety of dietary items and may exist in a variety of sizes at different life stages. T-REX estimated exposure on the following dietary items: short grass, tall grass, broadleaf plants/small insects, and fruits/pods/seeds/large insects, and seeds for granivores. The size classes of birds represented in T-REX were: small (20 g), medium (100 g), and large (1000 g). The size classes for mammals were: small (15 g), medium (35 g), and large (1000 g). EECs were calculated for the most sensitive dietary item and size class for birds (surrogate for terrestrial-phase amphibians and reptiles) and mammals. For mammals and birds, the highest EECs were consistently for the smallest size class consuming short grass.

T-REX also was used to calculate LD_{50}/ft^2 risk values and specialized risk analyses for granular and seed treatment applications. Conceptually, an LD_{50}/ft^2 is the amount of a pesticide estimated to kill 50% of exposed animals in each square foot of applied area. Although a square foot does not have defined ecological relevance, and any unit area could be used, risk presumably increases as the number of median lethal doses per square foot ($LD_{50}{\cdot}s/ft^2$) increases. The LD_{50}/ft^2 was used to estimate risk for granular formulations and granular broadcast, row, banded, and in-furrow applications. The LD_{50}/ft^2 was calculated using a toxicity value (weight-adjusted LD_{50}) and the EEC (mg a.i./ft^2) and directly compared with the Agency's LOCs. LD_{50}/ft^2 risk values were calculated for the uses summarized in **Table 15**. These uses represent the maximum application rates for each application type.

Table 15. Input Parameters for Applications Used to Derive LD_{50}/ft^2 Risk Values for Acephate and Methamidophos with T- REX.

Use	Application Type	Application Media	Application Rate (lbs a.i./A)		Row Spacing (in)	Bandwidth (in)	% Incorp-oration
			Acephate	Methami-dophos			
Cotton	Soil in-furrow	Granular[1]	1.0	0.8	30	6	0
Golf Course Turf	Broadcast	Granular	4.77	3.67	NA	NA	0
Beans / cranberry / cauliflower / celery / lettuce / mint / peanuts / peppers	Broadcast	Granular	1.0	0.8	NA	NA	0

[1]The in-furrow calculation applies to either granular or liquid.

An analysis of toxicity per granule could not be completed because granule size for acephate products was not available. The seed treatment analysis calculated acute and chronic RQs for birds and mammals based on dose (mg a.i./bw/day) and available pesticide (mg a.i./ft^2). The inputs included maximum seeding rates for the treated seeds and the maximum application rate of the pesticide to the seeds. The crops with approved acephate seed treatment uses and their maximum application rates are summarized in **Table 16**.

Table 16. Input Parameters for Seed Treatment Applications.

Crop	Maximum Seeding Rate (lbs/A)[1]	Application Rate (lbs a.i./cwt)	
		Acephate	Methamidophos
Cotton	18.9	0.320	0.246
Peanuts	228	0.197	0.152

[1] Becker and Ratnayake, 2011

Upper-bound Kenaga nomogram values reported by T-REX were used for derivation of dietary EECs for birds and mammals (**Table 17** and **Table 18**). For reference, mean Kenaga values, which tend to be approximately one third of the maximum (upper-bound) values, are not presented here and would not affect the risk conclusions in most cases.

Table 17. Upper-bound Kenaga Nomogram Acephate and Methamidophos EECs for Dietary- and Dose-based Exposures for Birds Derived Using T-REX

Use (Type of Application) App Rate (lb a.i./A), # Apps, Interval (days)	Dietary Category	Avian Dose-based EECs (mg/kg-bwt)			Avian Dietary based EECs (mg/kg-diet)
		20 g	100 g	1000 g	
Acephate					
Peppers, non-bell (aerial) 0.5, 2, 3	Short Grass	243	138	62.0	213
	Tall Grass	111	63.4	28.4	97.7
	Broadleaf plants	137	77.9	34.9	120
	Fruits/pods	15.2	8.65	3.87	13.3
	Arthropods	95.1	54.2	24.3	83.5
	Seeds	3.37	1.92	0.86	13.3
Celery/ mint (aerial) 1.0, 2, 3	Short Grass	485	277	124	426
	Tall Grass	223	127	57	195
	Broadleaf plants	273	156	70	240
	Fruits/pods	30	17	8	27
	Arthropods	190	108	49	167
	Seeds	7	4	2	27
Citrus (airblast) 4.0, 26, 7	Short Grass	2450	1400	625	2150
	Tall Grass	1120	640	286	985
	Broadleaf plants	1380	785	352	1210
	Fruits/pods	153	87	39	134
	Arthropods	959	547	245	842
	Seeds	34	19	9	134
Ornamentals (ground) 21.8, 26, 3	Short Grass	26600	15200	6780	23300
	Tall Grass	12200	6940	3110	10700
	Broadleaf plants	14900	8520	3810	13100
	Fruits/pods	1660	947	424	1460
	Arthropods	10400	5930	2660	9140
	Seeds	369	210	94.2	1460
Methamidophos					
Peppers, non-bell (aerial) 0.4, 2, 3	Short Grass	189	108	48.2	166
	Tall Grass	86.5	49.3	22.1	76.0
	Broadleaf plants	106	60.5	27.1	93.2
	Fruits/pods	11.8	6.73	3.01	10.4
	Arthropods	73.9	42.2	18.9	64.9
	Seeds	2.62	1.49	0.67	10.4
Celery/ Mint (aerial)	Short Grass	363	207	92.8	319

Use (Type of Application) App Rate (lb a.i./A), # Apps, Interval (days)	Dietary Category	Avian Dose-based EECs (mg/kg-bwt)			Avian Dietary based EECs (mg/kg-diet)
		20 g	100 g	1000 g	
0.8, 2, 3	Tall Grass	167	95.0	42.5	146
	Broadleaf plants	204	117	52.2	179
	Fruits/pods	22.7	13.0	5.80	19.9
	Arthropods	142	81.1	36.3	125
	Seeds	5.05	2.88	1.29	19.9
Citrus (airblast) 3.1, 26, 7	Short Grass	1610	919	411	1410
	Tall Grass	738	421	189	648
	Broadleaf plants	906	517	231	796
	Fruits/pods	101	57.4	25.7	88.4
	Arthropods	631	360	161	554
	Seeds	22.4	12.8	5.71	88.4
Ornamentals (ground) 16.8, 26, 3	Short Grass	16800	9560	4280	14700
	Tall Grass	7690	4380	1960	6750
	Broadleaf plants	9430	5380	2410	8280
	Fruits/pods	1050	598	268	920
	Arthropods	6570	3750	1680	5770
	Seeds	233	133	59.5	920

N/A = not applicable; App = Application

Table 18. Upper-bound Kenaga Nomogram Acephate and Methamidophos EECs for Dietary- and Dose-based Exposures for Mammals Derived Using T-REX.

Use (Type of Application) App Rate (lb a.i./A), # Apps, Interval (days)	Dietary Category	Mammalian Dose-based EECs (mg/kg-bwt)			Mammalian Dietary based EECs (mg/kg-diet)
		15 g	35 g	1000 g	
Acephate					
Peppers, non-bell (aerial) 0.5, 2, 3	Short Grass	203	140	32.6	213
	Tall Grass	93.1	64.4	14.9	97.7
	Broadleaf plants	114	79.0	18.3	120
	Fruits/pods	12.7	8.78	2.04	13.3
	Arthropods	79.6	55.0	12.8	83.5
	Seeds	2.82	1.95	0.45	13.3
Celery/ Mint (aerial) 1.0, 2, 3	Short Grass	406	281	65	426
	Tall Grass	186	129	30	195
	Broadleaf plants	229	158	37	240
	Fruits/pods	25	18	4	27
	Arthropods	159	110	26	167
	Seeds	6	4	0.9	27
Citrus (airblast) 4.0, 26, 7	Short Grass	2050	1420	328	2150
	Tall Grass	939	649	151	985
	Broadleaf plants	1150	797	185	1210
	Fruits/pods	128	89	21	134
	Arthropods	803	555	129	842
	Seeds	28	20	5	134
Ornamental (ground) 21.8, 26, 3	Short Grass	22200	15400	3560	23300
	Tall Grass	10200	7040	1630	10700
	Broadleaf plants	12500	8650	2000	13100
	Fruits/pods	1390	961	223	1460
	Arthropods	8710	6020	1400	9140
	Seeds	309	213	49.5	1460
Methamidophos					
Peppers, non-bell (aerial) 0.4, 2, 3	Short Grass	158	109	25.3	166
	Tall Grass	72.4	50.1	11.6	76.0
	Broadleaf plants	88.9	61.4	14.2	93.2
	Fruits/pods	9.87	6.82	1.58	10.4
	Arthropods	61.9	42.8	9.92	64.9
	Seeds	2.19	1.52	0.35	10.4

Use (Type of Application) App Rate (lb a.i./A), # Apps, Interval (days)	Dietary Category	Mammalian Dose-based EECs (mg/kg-bwt)			Mammalian Dietary based EECs (mg/kg-diet)
		15 g	35 g	1000 g	
Celery/ Mint (aerial) 0.8, 2, 3	Short Grass	304	210	48.7	319
	Tall Grass	139	96.3	22.3	146
	Broadleaf plants	171	118	27.4	179
	Fruits/pods	19.0	13.1	3.05	19.9
	Arthropods	119	82.3	19.1	125
	Seeds	4.22	2.92	0.68	19.9
Citrus (airblast) 3.1, 26, 7	Short Grass	1350	932	216	1410
	Tall Grass	618	427	99.1	648
	Broadleaf plants	759	524	122	796
	Fruits/pods	84.3	58.3	13.5	88.4
	Arthropods	528	365	84.6	554
	Seeds	18.7	13.0	3.00	88.4
Ornamentals (ground) 16.8, 26, 3	Short Grass	14000	9700	2250	14700
	Tall Grass	6430	4450	1030	6750
	Broadleaf plants	7900	5460	1270	8280
	Fruits/pods	877	606	141	920
	Arthropods	5450	3800	881	5770
	Seeds	195	135	31.2	920

N/A = not applicable; App = Application

T-REX was also used to calculate EECs for terrestrial invertebrates exposed to acephate (**Table 19** and**Table 20**). Available acute contact toxicity data for bees exposed to acephate (in units of µg a.i./bee), were converted to µg a.i./g (of bee) by multiplying by 1 bee/0.128 g. Dietary-based EECs calculated by T-REX for small insects (units of µg a.i./g) were used to estimate exposure to terrestrial invertebrates and compared to the adjusted acute contact toxicity data for bees to derive RQs.

Table 19. Summary EECs Used for Estimating Risk to Terrestrial Invertebrates and Derived Using T-REX for Acephate (Liquid Formulations).

Use, Method of Application	Application Rate (lbs a.i./acre), # of app, App interval (days)	Small Insect EEC (µg a.i./g)
Peppers, non-bell (aerial)	0.5, 2, 3	83.5
Celery/ mint (aerial)	1.0, 2, 3	167
Citrus (airblast)	4.0, 26, 7	842
Ornamentals (ground)	21.8, 26, 3	9140

N/A = not applicable; App = Application

Table 20. Summary EECs Used for Estimating Risk to Terrestrial Invertebrates and Derived Using T-REX for Methamidophos (Liquid Formulations).

Use, Method of Application	Application Rate (lbs a.i./acre), # of app, App interval (days)	Small Insect EEC (µg a.i./g)
Peppers, non-bell (aerial)	0.4, 2, 3	64.9
Celery/ mint (aerial)	0.8, 2, 3	125
Citrus (airblast)	3.1, 26, 7	554
Ornamentals (ground)	16.8, 26, 3	5770

N/A = not applicable; App = Application

Terrestrial Plant Exposures

TerrPlant (Version 1.2.2) was used to calculate EECs for non-target plant species inhabiting dry and semi-aquatic areas. Parameter values for application rate, drift assumption, and incorporation depth were based on the use and related application method (**Table** 20). EECs for terrestrial plant exposure are listed by use in **Table 21**. TerrPlant does not account for degradation; therefore, the results obtained from the TerrPlant analysis are likely conservative for acephate given its relatively rapid degradation profile. However, TerrPlant also models only a single application while many acephate products may be applied multiple times with varying intervals between applications. Risk was assessed separately for acephate and methamidophos based on assumptions that each was present one-hundred percent and adjusting the application rate for methamidophos by the respective molecular weights and using the different respective plant toxicities. Exposures for methamidophos were calculated by applying a correction factor: 0.77 for the molecular weight difference (141.13/183.16 = 0.77). Cumulative risk of the two chemical species was not calculated since the applied chemical would be assumed to be in one state or the other and so the actual risk would fall within the range between the two risk calculations—the compound with the highest calculated risk was therefore used as a conservative estimate of risk.

Table 21. TerrPlant Inputs and Resulting EECs for Plants Inhabiting Dry and Semi-aquatic Areas Exposed to Acephate via Runoff and Drift.

Use	Application Rate (lbs a.i./A)		Applica-tion method (Incorpora-tion [in])	Runoff Fraction (solubility >100 ppm)[2]	Drift Value (%)	Acephate / Methamidophos EEC		
	Acephate	Methami-dophos[1]				Spray drift EEC (lbs a.i./A)	Dry area EEC (lbs a.i./A)	Semi-aquatic area EEC (lbs a.i./A)
Peppers, non-bell	0.50	0.40	Aerial (1)	0.05	5	0.025/ 0.020	0.050/ 0.040	0.28/ 0.22
Celery/ mint	1.0	0.80	Aerial (1)	0.05	5	0.050/ 0.040	0.10/ 0.080	0.55/ 0.44
Citrus 1	4.0	3.1	Airblast (1)	0.05	5	0.20/ 0.16	0.40/ 0.31	2.2/ 1.7
Ornamentals	21.8	16.8	Ground (1)	0.05	1	0.218/ 0.168	1.31/ 1.01	11.1/ 8.57

[1] Calculated using the ratio of the molecular weights of acephate and methamidophos (141.13/183.16 = 0.77).
[2] Acephate solubility = 835,000 mg/L (

Table 6); methamidophos solubility = 200,000 mg/L (**Table 9**).

Table 22. EECs for Acephate and Methamidophos Exposure to Off-field Non-target Plants.

Exposure Description	Equation	EEC (lbs a.i./acre)	
		Acephate	Methamidophos
Runoff to dry areas	(A/I)*R	0.025-8.1	0.020-6.2
Runoff to semi-aquatic areas	(A/I)*R*10	0.25-81	0.20-62
Spray drift	**A*D**	0.025-1.62	0.020-1.24
Total for dry areas	**((A/I)*R)+(A*D)**	0.050-9.72	0.040-7.44
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	0.28-82.6	0.22-63.2

A= application rate (in lbs ai/acre – see **Table 21**)
I = incorporation depth (=1 inch, default)
R = runoff fraction (=0.05, for solubility >100mg/L)
D = drift fraction (=0.01for ground spray; 0.05 for aerial)

4. EFFECTS ANALYSIS

The ecological effects characterization for acephate was based mostly on registrant-submitted toxicity data for the technical grade active ingredient (TGAI), the degradate, methamidophos, and typical end-use products (TEPs). A list of these studies is found in **Appendix C** and a summary of all available ecological toxicity data considered for acephate and methamidophos is found in **Appendix D**. **Appendix D** also contains pertinent toxicity data from the open literature, obtained by screening the ECOTOX database for any useable endpoints more sensitive than those already known (**Appendix E**). The most sensitive endpoints used in risk calculations are presented below in **Table 25** to **Table 28** (**Section 4.1**).

Acute toxicity to fish and aquatic invertebrates was categorized using the system shown in **Table 23** (USEPA, 2004). Toxicity categories for aquatic plants have not been defined nor have categories been developed to characterize chronic toxicity to aquatic organisms.

Table 23. Categories of Acute Toxicity for Fish and Aquatic Invertebrates.

LC_{50} (mg/L)	Toxicity Category
< 0.1	Very highly toxic
> 0.1 - 1	Highly toxic
> 1 - 10	Moderately toxic
> 10 - 100	Slightly toxic
> 100	Practically non-toxic

Acute toxicity to terrestrial animals was categorized using the classification system shown in

Table 24 (USEPA, 2004). Toxicity categories for terrestrial plants have not been defined nor have categories been developed to characterize chronic toxicity to terrestrial organisms.

Table 24. Categories of Acute Toxicity for Avian and Mammalian Studies.

Oral LD_{50}	Dietary LC_{50}	Toxicity Category
< 10 mg/kg	< 50 mg/kg-diet	Very highly toxic
10 - 50 mg/kg	50 - 500 mg/kg-diet	Highly toxic
51 - 500 mg/kg	501 - 1000 mg/kg-diet	Moderately toxic
501 - 2000 mg/kg	1001 - 5000 mg/kg-diet	Slightly toxic
> 2000 mg/kg	> 5000 mg/kg-diet	Practically non-toxic

4.1. Toxicity Profile for Acephate

Aquatic Taxa

Acephate is moderately toxic to freshwater and estuarine/marine invertebrates, practically non-toxic to freshwater fish, and slightly toxic to estuarine/marine fish on an acute exposure basis (**Table 25**).

Table 25. Aquatic Toxicity Profile for Acephate.

Taxa Represented	Assessment Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation or MRID	Study Classification and Comments
Freshwater fish (also surrogate for aquatic-phase amphibians)[1]	Acute	Rainbow Trout (*Oncorhynchus mykiss*)	96-hr LC_{50} = 852 mg a.i./L slope = no data	48650401	Supplemental (Quantitative)
	Chronic	Rainbow Trout	NOAEC = 5.9 mg a.i./L	Calculated[2]	Extrapolated using most sensitive acute 96-h LC_{50} for rainbow trout (852 mg a.i./L) divided by 144 (highest rainbow trout acute-to-chronic ratio (ACR) for organophosphates)
Freshwater invertebrates	Acute	Water flea (*Daphnia magna*)	48-hr EC_{50} = 1.1 mg a.i./L slope = 1.6 (0.95-2.3)	MRID 47116601	Acceptable
	Chronic	Water flea (*D. magna*)	NOAEC = 0.15 mg a.i./L LOAEC = 0.375 mg a.i./L	MRID 44466601	Supplemental (Quantitative) Based on average no. young per female per day
Estuarine/ marine fish	Acute	Pin Fish (*Lagodon rhomboides*)	96-hr LC_{50} = 85 mg a.i./L slope = no data	MRID 40228401	Supplemental (Quantitative)
	Chronic	No data	No data	No data	No data
Estuarine/ marine invertebrates	Acute	Pink Shrimp (*Penaeus durorarum*)	96-hr LC_{50} = 3.8 mg a.i./L slope = no data	MRID 40228401	Supplemental (Quantitative)
	Chronic	Mysid Shrimp (*Americanysis bahia*)	NOAEC = 0.58 mg a.i./L LOAEC = 0.62 mg a.i./L	MRID 00066341	Supplemental (Quantitative) Based on survival
Aquatic plants	Vascular	Duckweed (*Lemna gibba*)	NOAEC = 253 mg a.i./L EC_{50} >1040 mg a.i./L slope = no data	MRID 48879503	Acceptable NOAEC based on dry weight biomass and growth rate; EC_{50} based on frond number yield
	Non-vascular	Green Algae (*Pseudokirchneriella subcapitata*)	NOAEC = 1040 mg a.i./L EC_{50} >1040 mg a.i./L slope = no data	MRID 48879501	Acceptable NOAEC and EC_{50} based on yield, growth rate and cell density

[1] An endpoint was available for the green frog (MRID 00093943, see **Appendix D**) but only from 24-hr exposure; although the endpoint was determined to be quantitative for a 24-hr exposure, the 96-hr fish endpoint was used.
[2] NOAEC calculated using an acute to chronic ratio of 144 (see explanation following **Table 21**).

Since there were no chronic data for freshwater fish with survival, growth, or reproductive endpoints submitted or found in the open literature, an acute to chronic ratio (ACR) was determined using other organophosphate insecticide data. The methodology used to derive this ACR and chronic fish NOAEC for acephate (further described in **Appendix D)** was based on an ACR for dichlorvos (a structurally-similar chemical) of 144 [750 ppb a.i. (acute LC_{50}, MRID 43284702) / 5.2 ppb a.i. (chronic NOAEC, MRID 43788001) = 144]; this ACR value was also used to estimate chronic risk from methamidaphos to freshwater fish. The estimated chronic NOAEC for rainbow trout was derived as follows:

ACR = 144
Estimated chronic NOAEC for acephate = 852/144 = 5.9 ppm a.i.

There were no data available with which to determine a chronic NOAEC for estuarine/marine fish.

The chronic NOAECs for freshwater and estuarine/marine invertebrates were 0.15 mg a.i./L and 0.58 mg a.i./L, respectively. For both vascular and nonvascular aquatic plants exposed to acephate the 5-day EC_{50} was >1040 mg a.i./L; the NOAEC for vascular and non-vascular aquatic plants were 253 and >1040 mg a.i./L, respectively.

A more detailed description of acute and chronic toxicity data for aquatic taxa, including data from the open literature, are provided in **Appendix D**.

The degradate, methamidophos, is very highly toxic to freshwater invertebrates, slightly toxic to freshwater fish, and moderately toxic to estuarine/marine invertebrates and fish on an acute exposure basis (**Table 26**).

Table 26. Aquatic Toxicity Profile for Methamidophos.

Taxa Represented	Assessment Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation or MRID	Study Classification and Comments
Freshwater fish (also surrogate for aquatic-phase amphibians)[1]	Acute	Rainbow Trout	96-hr LC_{50} = 25 mg a.i./L slope = 9.2	MRID 00041312	Supplemental (Quantitative)
	Chronic	Rainbow Trout	NOAEC = 0.17 mg a.i./L	Calculated[1]	Extrapolated using most sensitive acute 96-h LC_{50} for Rainbow trout (25 mg a.i./L) divided by 144 (highest rainbow trout acute to chronic ratio for organophosphates)
Freshwater invertebrates	Acute	Water flea (*D. magna*)	48-hr EC_{50} = 0.026 mg a.i./L slope = 4.9	MRID 00041311	Supplemental (Quantitative)
	Chronic	Water flea (*D. magna*)	NOAEC = 0.0045 mg a.i./L LOAEC = 0.0053 mg a.i./L	MRID 46554501	Supplemental (Quantitative) Based on adult dry weight
Estuarine/ marine fish	Acute	Sheepshead Minnow (*Cyprinodon variegates*)	96-hr LC_{50} = 5.63 mg a.i./L slope = no data	MRID 00144431	Acceptable
	Chronic	No data	No data	No data	No data
Estuarine/ marine invertebrates	Acute	Mysid Shrimp	96-hr LC_{50} = 1.05 mg a.i./L slope = no data	MRID 00144430	Acceptable
	Chronic	Mysid Shrimp	NOAEC = 0.174 mg a.i./L LOAEC = 0.360 mg a.i./L	MRID 46646001	Acceptable Based on dry weight.
Aquatic plants[2]	Vascular	Duckweed	NOAEC = 1.42 mg a.i./L EC_{50} = 3.65 mg a.i./L	MRID 48879504	Acceptable NOAEC based on frond yield, dry weight and growth rate; EC_{50} based on frond yield
	Non-vascular	Green Algae (*P. subcapitata*)	NOAEC = 29.5 mg a.i./L EC_{50} = 679 mg a.i./L	MRID 48879502	Acceptable NOAEC based on dry wt., growth rate and frond number yield; EC_{50} based on frond number yield

[1] NOAEC calculated using an acute to chronic ratio of 144 (see explanation following **Table 21** and below).

The reproductive NOAECs for freshwater and estuarine/marine invertebrates were 0.0045 mg a.i./L and 0.174 mg a.i./L, respectively. As with acephate, no chronic freshwater fish studies were available for methamidophos. Therefore, consistent with the previous methodology applied to methamidaphos, an ACR of 144 (same as for acephate) was used to estimate a chronic NOAEC for freshwater fish (also see **Appendix D**). The calculation was as follows:

ACR = 144
Estimated Trout NOAEC for methamidophos = 25/144 = 0.17 mg a.i./L

There were no data available with which to determine a chronic NOAEC for estuarine/marine fish and with the estuarine/marine fish acute toxicity estimate being more sensitive than the freshwater fish estimate, chronic methamidophos toxicity to saltwater fish species is an uncertainty.

Methamidophos is more toxic to vascular and non-vascular aquatic plants than acephate, with EC_{50} values of 3.65 and 679 mg a.i./L. Another non-vascular endpoint was found in a review of the open literature, with a more sensitive diatom endpoint than the green algae (*Pseudokirchneriella subcapitata*) endpoint. The NOAEC's of 1.42 and 29.5 mg a.i./L were available for the duckweed *(Lemna gibba*) and green algae.

A more detailed description of acute and chronic toxicity data for aquatic taxa, including data from the open literature, is provided in **Appendix D**.

Terrestrial Taxa

Acephate is moderately toxic to avian species on an acute oral and subacute dietary exposure basis, and moderately toxic to mammals on an acute oral exposure basis. Acephate is classified as highly toxic to terrestrial invertebrates on an acute contact exposure basis (**Table 27**). However, pollinator studies associated with new Agency guidance[9] have not yet been submitted (also see the USDA publication on the attractiveness of crops to bees, USDA, 2015).[10]

[9] USEPA *et al.* 2014. Guidance for Assessing Pesticide Risks to Bees. Available at: http://www2.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance
[10] Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen. Available at: http://www.ree.usda.gov/ree/news/Attractiveness_of_Agriculture_crops_to_pollinating_bees_Report-FINAL.pdf

Table 27. Terrestrial Toxicity Profile for Acephate.

Taxa Represented	Assessment Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation or MRID[1]	Study Classification and Comments
Birds (also surrogate for terrestrial-phase amphibians and reptiles)	Acute	Zebra Finch (*Taeniopygia guttata*)	LD_{50} = 86.9 mg a.i./kg-bw slope = 7.3 (3.4-11.1)	MRID 48924601	Acceptable
	Subacute Dietary	Japanese quail (*Coturnix japonica*)	LC_{50} = 718 mg a.i./kg-diet	MRID 40910905	Supplemental (Quantitative)
	Chronic	Mallard duck (*Anas platyrhynchos*)	NOAEC = 5 mg a.i./kg-diet LOAEC = 20 mg a.i./kg-diet	MRID 00029691	Acceptable Based on reduced # viable embryos and live embryos at 3-weeks
Mammals	Acute	Meadow vole (*Microtus pennsylvanicus*)	LD_{50} = 321mg a.i./kg-bw slope = 5.18	E038448	Acceptable
	Chronic	Rat (*Rattus norvegicus*)	3- generation reproductive study NOAEC = 50 mg a.i./kg-diet LOAEC = 500 mg a.i./kg-diet	MRID 40323401, 40605701	Acceptable Based on parental and pup weight, food consumption, litter size, mating performance and viability
Terrestrial invertebrates	Acute Contact	Honey bee (*Apis mellifera*)	LD_{50} = 1.20 µg a.i./bee = 9.4 µg a.i./g [2] slope = 8.26	MRID 00014714, 44038201	Acceptable
		Soybean looper larvae (*Pseudoplusia includes*)	72-hr LD_{50} = 0.66 µg a.i./larvae = 20.34 µg a.i./g slope = 2.4 (±0.36)	MRID 48650402	Supplemental (Quantitative)
Terrestrial plants	Seedling Emergence Monocots	All four species tested.[3]	EC_{25} >3.96 lb a.i./A NOAEC = 3.96 lb a.i./A	MRID 46173203	Acceptable
	Dicots	All six species tested.[4]	EC_{25} >3.96 lb a.i./A NOAEC = 3.96 lb a.i./A	MRID 46173203	Acceptable
	Vegetative Vigor Monocots	All four species tested.[3]	EC_{25} >3.96 lb a.i./A NOAEC = 3.96 lb a.i./A	MRID 46173204	Acceptable
	Dicots	All six species tested.[4]	EC_{25} >3.96 lb a.i./A NOAEC = 3.96 lb a.i./A	MRID 46173204	Acceptable

[1] ECOTOX references were designated with an E followed by the ECOTOX reference number.
[2] Using the average adult honey bee weight of 0.128 g.
[3] Monocots tested: corn, wheat, onion and ryegrass.
[4] Dicots tested: buckwheat, soybean, lettuce, flax, tomato and radish.

The avian reproductive NOAEC for acephate was 5 mg a.i./kg-diet and the mammalian 3-generation reproductive NOAEL was 50 mg a.i./kg-body weight. The acute contact LD_{50} for the honey bee (*A. mellifera*) was 1.2 µg a.i./bee (or 9.4 µg a.i./g of bee). Terrestrial plants exposed to acephate have an EC_{25} of >3.96 lb a.i./A for both seedling emergence and vegetative vigor. The NOAEC for both these effects was 3.96 lb a.i./A.

The degradate, methamidophos, is very highly toxic to avian species on an acute oral and subacute dietary exposure basis, and highly toxic to mammals on an acute oral exposure basis. Methamidophos is classified as highly toxic to terrestrial invertebrates on an acute contact exposure basis (**Table 28**).

Table 28. Terrestrial Toxicity Profile for Methamidophos.

Taxa Represented	Assessment Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation or MRID[1]	Study Classification and Comments
Birds (also surrogate for terrestrial-phase amphibians and reptiles)	Acute	Common grackle (*Quiscalus quiscula*)	LD_{50} = 6.7 mg a.i./kg-bw slope = 4.6	MRID 00144428	Supplemental (Quantitative)
	Subacute Dietary	Bobwhite quail (*Colinus virginianus*)	LC_{50} = 42 mg a.i./kg-diet	MRID 00093904	Supplemental (Quantitative)
	Chronic	Mallard duck	NOAEC = 3 mg a.i./kg-diet LOAEC = 5 mg a.i./kg-diet	MRID 00014114	Acceptable Based on egg thickness, viable embryos, embryo survival, and 14-day old chick survival.
Mammals	Acute	Norway Rat	LD_{50} = 15.6 a.i./kg body weight slope = 13	MRID 00014044	Acceptable
	Chronic	Norway Rat	3- generation reproductive study NOAEL = 0.5 mg a.i./kg-bw/day (10 mg a.i./kg-diet) LOAEL = 1.65 mg/kg-bw/day (33 mg a.i./kg-diet)	MRID 00148455, 41234301	Acceptable Based on decrease in number of births, pup viability and body weight.
Terrestrial invertebrates	Acute Contact	Honey bee (*Apis mellifera*)	LD_{50} = 1.37 µg a.i./bee = 10.7 µg/g [2] slope = 10.32	MRID 00036935	Acceptable
		Western spruce budworm larvae (*Choristoneura occidentalis*)	24-hr LD_{50} = 7.45 µg a.i./g slope = 3.37	48650403	Supplemental (Quantitative)
Terrestrial plants	Seedling Emergence Monocots	All four species tested.[3]	EC_{25} >4.0 lb a.i./A NOAEC = 4.0 lb a.i./A	MRID 46655802	Acceptable
	Dicots	All six species tested.[4]	EC_{25} >4.0 lb a.i./A NOAEC = 4.0 lb a.i./A	MRID 46655802	Acceptable
	Vegetative Vigor Monocots	All four species tested.[3]	EC_{25} >4.0 lb a.i./A NOAEC = 4.0 lb a.i./A	MRID 46655802	Acceptable
	Dicots	All ten species tested.[4]	EC_{25} >4.0 lb a.i./A NOAEC = 4.0 lb a.i./A	MRID 46655802	Acceptable

[1] ECOTOX references were designated with an E followed by the ECOTOX reference number.
[2] Using the average adult honey bee weight of 0.128 g.
[3] Monocots tested: corn, oat, onion and ryegrass.
[4] Dicots tested: cabbage, cucumber, lettuce, radish, soybean and tomato.

The avian reproductive NOAEL for methamidophos was 3 mg a.i./kg-diet and the mammalian 2-generation reproductive NOAEL was 0.5 mg a.i./kg bw/day. The acute contact LD_{50} for the honey bee (*A. mellifera*) was 1.4 µg a.i./bee (or 10.7 µg a.i./g of bee), a similar, but slightly less sensitive endpoint than the one for acephate. For methamidophos, an endpoint from another insect (the study data were deemed useable even though the species may be considered a target species) was found to be more sensitive than the honey bee endpoint – the acute contact LD_{50} for larvae of the spruce budworm (*Choristoneura occidentalis*) was 7.5 µg a.i./g of larvae. Terrestrial plants exposed to methamidophos showed no significant adverse effects on seedling emergence or vegetative vigor at the maximum rate tested, 4.0 lb a.i./A.

4.2. Endocrine Disruptor Screening Program

As required by FIFRA and FFDCA, EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of the Preliminary Problem Formulation for Registration Review (DP Barcode 342370), EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), acephate is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[11] and includes some pesticides scheduled for registration review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors.

[11] See http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0477-0074 for the final second list of chemicals.

Acephate is on List 1 for which EPA has received all of the required Tier 1 assay data. The Agency has reviewed all of the assay data received for the appropriate List 1 chemicals and the conclusions of those reviews are available in the chemical-specific public dockets (see EPA-HQ-OPP-2009-0634-0146 and EPA-HQ-OPP-2009-0634-0157 for acephate). For further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and the Tier 1 screening battery, please visit our website.[12]

4.3. Incidents

A review of the Ecological Incident Information System (EIIS, version 2.1), the 'Aggregate Incident Reports' (v. 1.0) database, and the Avian Monitoring Information System (AIMS) for ecological incidents involving acephate was completed on June 12, 2014; the EIIS and IDS querries was updated on January 21, 2016. The results of these reviews for terrestrial, plant, and aquatic incidents are discussed below. A complete list of the reported incidents involving acephate and methamidophos is found in **Appendix F**. Note that a lack of reported incidents does not imply that no incidents occurred.

Although there were reported incidents of adverse effects to non-target plants and animals from acephate, many of these reports were not clearly documented or report acephate applied in combination with or in the presence of other pesticides. In the latter case, it was not possible to determine which pesticide caused the incident. This especially applied to reported fish-kill incidents. The majority of acephate-specific incidents reported were honey bee (*Apis mellifera*) kills. Incidents were also reported for bird, rabbit and domestic animal mortalities, as well as damage to plants, although no information was available to ascertain the extent or type of damage to plants.

Overall, the EIIS results for acephate included 5 aquatic incidents, 14 plant incidents, and 15 terrestrial incidents. All 34 incidents were categorized in EIIS for legality, which indicates the legal status of the pesticide use. All reported incidents, except one, were categorized as "Registered Use" or "Undetermined;" one was categorized as misuse. Five (5) plant, 4 aquatic, and 5 terrestrial incidents were categorized as "Registered Use." The certainty index[13] (**Table 29**) determinations for aquatic incidents were from unlikely to highly probable for acephate causality. The plant incidents were all possibly or probably caused by acephate. The terrestrial incidents were possibly or probably caused by acephate except for one incident that was classified as highly probable.

[12] http://www.epa.gov/endo/

[13] http://www.epa.gov/pesticides/science/efed/policy_guidance/team_authors/endangered_species_reregistration_workgroup/esa_incident_guidance.htm#defining

Table 29. The certainty index in EIIS is based on the following.

Certainty Index	Criteria
Highly probable	Pesticide was confirmed as the cause through residue analysis or other reliable evidence, or the circumstances of the incident along with knowledge of the pesticide's toxicity or history of previous incidents give strong support that this pesticide was the cause.
Probable	Circumstances of the incident and properties of the pesticide indicate that this pesticide was the cause, but confirming evidence is lacking.
Possible	The pesticide possibly could have caused the incident, but there are possible explanations that are at least as plausible. Often used when organisms were exposed to more than one pesticide.
Unlikely	Evidence exists that a stressor other than exposure to this pesticide caused the incident, but that evidence is not conclusive.
Unrelated	Conclusive evidence exists that a stressor other than exposure to the given pesticide caused the incident.

The AIMS database identified multiple bird kills connected with presence of both acephate and methamidophos (54 and 43 incidents, respectively, AIMS and EIIS incidents may overlap in some cases).

The EIIS results for methamidophos included 3 terrestrial plant incidents and 15 terrestrial animal incidents. The certainty index for the plant incidents was either unlikely or possible for methamidophos causality and these incidents were the result of either "Registered Use"or "Undetermined" use. Terrestrial animal incidents were either possible or probable for methamidophos causality except for one incident that was highly probable. The terrestrial incidents were the result of either "Registered" or "Unknown" uses, with one "Accidental Misuse" reported (with a certainty of probable).

The Aggregate Incident Reports database contained 11 minor fish and wildlife incidents and 453 minor plant incidents for acephate. No detailed information was available for these incidents. There were no methamidophos incidents in that database.

Aquatic Incidents

Although five fish-kill incidents involved acephate, none were clearly attributable to a registered use of acephate, alone, i.e., either the application rate was unclear or other active ingredients were also involved. In 1991, a tobacco farmer in North Carolina (I000799-009) sprayed an acephate-containing product before a heavy rain resulting in a fish kill, but the application rate was not confirmed. In 1992, a fish kill occurred in a backyard pond in Allegheny County, Penn. (I000468-001) as a result of a tank mix of acephate, diazinon, and chlorpyrifos treatment for residential trees. Application was deemed to be in accordance with the label, but application rate, fish species and number of dead fish were not available and no water or fish tissues were analyzed. Acephate is less toxic to fish than the other two chemicals. Another incident in 1993 (I000592-001) involved application of acephate (to cotton) just before a heavy rain, resulting in a fish kill; however, azinphos-methyl was also present in concentrations toxic to fish. Similarly, in 2010 in Charlotte County, Florida, a fish-kill (I022297-003) involving acephate application also involved chlorothalonil. The only fish-kill rated "probable" for acephate causality (I000256-020) also involved endosulfan. Both acephate and endosulfan were regarded as probable contributers.

Terrestrial Incidents

An incident in South Carolina in 1998 (I007109-001) involved 24 dead boat-tailed grackles (*Quiscalus major*). Methamidophos residues detected in affected birds and the incident was attributed to acephate use on fire ants. This incident was classified as "probable" for acephate causality. A similar incident also in South Carolina in 2005 (I016176-001) involved 50 boat-tailed grackles found dead. Acephate had been used in the area to control fire ants according to the label restrictions and acephate residues were found within some of the birds. This incident was classified as "highly probable" cause by acephate. One incident in Texas in 2002 (I013135-001) involved an acephate-containing fire ant product "possibly" causing the death of a rabbit and a bird, but no details were available on the legality of the use.

Washington State reported 4 incidents of bee kills from 1992 to 2002 (I014409- 064, -065, -067 and -068). Honey bee colonies (40 – 60) were killed in each of the reported incidents and all four incents were classified as "probable" for acephate causality. Washington also reported 7 incidents of bee kills due to methamidophos (see **Appendix F** for incident numbers) during this time period. Between 30 and 500 colonies were killed per incident. The largest incident (I013884-010), with 500 colonies killed, was classified as "highly probable" that it was caused by methamidophos. Of the remaining bee kills, three were classified as "probable" and three as "possible" cause by methamidophos. Most of these did not include tests for residues, rather, the state of Washington sent out inspectors to the sites to record the incidents. The most recent incidents involving pollinators were not clearly attributable to acephate: in I026563-001, sidewalks were reportedly littered with dead and dying bumble bees the day after trees were treated with pesticides—bees collected had tissue concentrations of 0.05 ug imidacloprid/bee and 0.30 ug acephate/bee. The other recent incident (I027663-001) involved multiple deaths of an unidentified butterfly species, but the role of acephate was unclear since other ingredients (including bifenthrin and imidacloprid) were also involved.

The Incident Data System which captures pesticide incidents submitted to the Agency under FIFRA 6(a)2, was searched for domestic animal incidents due to acephate and methamidophos (**Table 30**). Only summary data were available from this search. In IDS domestic animals typically refer to household pets, but sometimes includes other domestic animals such as geese, chickens, cattle and horses. Of the 2081 incidents reported in the Aggregate database between 1995 and present (January 21, 2016), 1611 of these (77%) were domestic animal incidents, 11 (0.5%) wildlife, and 459 (22%) plant incidents. Although a detailed analysis was not possible, many of these also involved other active ingredients and so causality is unclear. However, the recognition of acephate as a potential contributor by incident investigators does add important evidence that the route of exposure exists for both plants and animals.

Table 30. Ecological and Domestic Animal Incidents Associated with Acephate and Methamidophos, According to the IDS Database.[1]

Exposure Severity Code	Description	Number of Incidents	% of Total Incidents
DA	Domestic Animal - Fatality	120	6
DB	Domestic Animal - Major	77	4
DC	Domestic Animal - Moderate	564	27
DCDE	Domestic Animal - Moderate, Minor and Unknown	40	2.5
DD	Domestic Animal - Minor	757	36
DE	Domestic Animal - Unspecified	53	3
ONT	Other Nontarget	0	0
PB	Plant Damage - Minor	459	22
WB	Wildlife - Minor	11	0.5
	Total:	2081	100

[1] Queried January 21, 2016 (1990-present).

Plant Incidents

The reported plant incidents from acephate applications with information available are listed below. Note that the products used in five of the seven incidents described below have since been voluntarily cancelled by the registrant. The three cancelled products involved in these incidents were all formulated with mixtures of acephate and other insecticides (see **Appendix F** for product details). All of the incidents described below involved damage to plants sprayed directly with the product rather than as a result of spray drift from a separate target area.

In 1994 in Penn. (I001777-002), Orthenex Rose and Flower Spray (an aerosol containing acephate) was alleged to have caused damage to ornamentals and/or flowers. However, Weed-B-Gone (dicamba herbicide) and Greensweep (2,4-D herbicide) were also involved and so causality was uncertain.

In 1998 in Florida (I007350-619), an allegation was made of plant damage from the use of Ortho Systemic Rose and Floral Spray (containing acephate) on ornamentals. The causality was determined to be "possible" for acephate and the legality of the use was unknown. This product was voluntarily cancelled by the registrant on June 1, 2011. Also in 1998 in Penn. (I007340-704) another allegation was made of plant damage from the use of Ortho Orthenex™ Insect and Disease Control Formula III (containing acephate) on ornamentals. The causality was determined to be "possible" for acephate, but the use legality was unknown. This product was voluntarily cancelled by the registrant on October 14, 2008.

In 1999 in DC (I009262-105), an allegation was made of plant damage from the use of Isotox Insect Killer Formula IV (containing acephate). The product was sprayed on a dwarf Alberta pine preceding the death of the tree. Causality was determined to be "probable" for acephate with unknown use legality. This product was voluntarily cancelled by the registrant on October 14, 2008. In 1999 in Indiana (I009262-116), an allegation was made of plant damage from the use of Ortho Orthenex™ Insect and Disease Control Formula III (containing acephate) on ornamentals. The report indicated that flowering almond and hibiscus were dying – causality was "probable" for acephate from a registered use. This product was voluntarily cancelled by the registrant on October 14, 2008. Another incident in 1999 in Texas (I009262-117), also involved this product. An allegation was made of plant damage from its use on ornamentals. The report indicated that the homeowner applied this product on 40 – 50 bushes used as hedge per recommendation of county extension agent. Approximately 95% of the bushes died. Causality was "probable" for acephate from a registered use. In 1999 in Georgia (I009262-091), an allegation was made of plant damage from the use of Ant-Stop Orthene™ Fire Ant Kill (containing acephate). The product was applied on spots of the lawn resulting in "burnt spots." Causality was determined to be "probable" for acephate, but with unknown use legality. As mentioned above, the three cancelled products all involved other active ingredients in addition to acephate and so, though multiple reports exist of acephate's possible involvement in plant damage, acephate's role was uncertain.

Plant incidents were also found in the IDS database query (see **Table 30**) and as mentioned above, 459 (22%) of the 2081 reported incidents were plant incidents. Though available information did not allow for a detailed analysis, as for animal incidents, the recognition of acephate as a potential contributor by incident investigators adds important evidence that the route of exposure exists for damage to plants.

5. RISK CHARACTERIZATION

For this preliminary assessment of acephate, the deterministic RQ method was used to provide a metric of potential risks. The RQ is a comparison of acute or chronic exposure estimates to toxicity endpoints (*i.e.*, RQ = EEC/toxicity endpoint). The resulting RQs were compared to the Agency's respective acute or chronic risk levels of concern (LOC). These criteria were used to indicate when the use of a pesticide, as directed on the label, has the potential to cause adverse effects to non-target organisms. For acute and chronic risks to non-listed animals, the LOCs are 0.5 and 1.0, respectively, and for plants, the LOC is 1.0. For each taxa, RQs are generated and potential risks are discussed. This discussion includes consideration of additional lines of evidence such as incident data.

5.1. Risk Calculation

Aquatic Organisms

Aquatic Animals

Risk calculations for aquatic organisms from acephate use (based on methamidophos exposure and toxicity estimates) are presented in **Table 31** and **Table 32** with uses grouped in some cases where exceedances did not occur over a range of use rates. See **Appendix G** for the complete set of RQs based on both acepate parent and methamidophos degradate data for all outdoor uses and taxanomic groups assessed.

Table 31. Maximum RQ Values for Fish and Aquatic Invertebrates from Acephate Uses.

Use Site	EECs (µg a.i./L)		RQ[1]						
			Freshwater Invertebrates[2]		Saltwater Invertebrates[3]		Freshwater Fish[4]		Saltwater Fish[5]
	Peak	Chronic (21-d/60-d)	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute
A & Q) cotton	32.6	8.84/3.77	**1.25**	**1.96**	0.03	0.05	<0.01	0.02	<0.01
B) wasteland	37.5	14.0/9.56	**1.44**	**3.11**	0.04	0.08	<0.01	0.06	<0.01
C&N) peanuts, seed treatment	17.1	5.97/2.81	**0.66**	**1.33**	0.02	0.03	<0.01	0.02	<0.01
D) peppers, non-bell	17.4	3.97/1.42	**0.67**	0.88	0.02	0.02	<0.01	<0.01	<0.01
E) Christmas trees	77.7	32.0/21.5	**2.99**	**7.11**	**0.07**	0.18	<0.01	0.13	0.01
F) cranberry	0	0/0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
G) soybeans	10.8	4.51/1.65	**0.42**	**1.00**	0.01	0.03	<0.01	0.01	<0.01
I) beans	15.1	6.21/2.38	**0.58**	**1.38**	0.01	0.04	<0.01	0.01	<0.01
J) cauliflower	37.5	8.21/2.89	**1.44**	**1.82**	0.04	0.05	<0.01	0.02	<0.01
K) celery	10.1	5.46/2.29	**0.39**	**1.21**	0.01	0.03	<0.01	0.01	<0.01
L) mint	9.00	4.37/2.10	**0.35**	0.97	<0.01	0.03	<0.01	0.01	<0.01
M) peppers	29.3	0.438/0.339	**1.13**	0.10	0.03	<0.01	<0.01	<0.01	<0.01
O) tobacco	11.2	3.83/1.58	**0.43**	0.85	0.01	0.02	<0.01	0.01	<0.01
P) lettuce	16.7	8.48/3.38	**0.64**	**1.88**	0.02	0.05	<0.01	0.02	<0.01
R) southern pine orchard seedlings	47.5	9.21/4.33	**1.83**	**2.05**	**0.05**	0.05	<0.01	0.03	<0.01
S) rights-of-way	3.02	1.33/1.08	**0.12**	0.30	<0.01	<0.01	<0.01	0.01	<0.01
T) alfalfa	13.0	4.32/1.57	**0.50**	0.96	0.01	0.03	<0.01	0.01	<0.01
U) grapes 1	31.0	14.0/11.0	**1.19**	**3.11**	0.03	0.08	<0.01	0.06	<0.01
V) citrus 2	38.1	11.7/7.09	**1.47**	**2.60**	0.04	0.07	<0.01	0.04	<0.01
W) grapes 2	30.6	18.2/12.7	**1.18**	**4.04**	0.03	0.11	<0.01	0.07	<0.01
X) almonds, non-bearing	42.1	11.1/6.62	**1.62**	**2.47**	0.04	0.06	<0.01	0.04	<0.01
Y) apples, non-bearing	15.7	7.87/6.57	**0.60**	**1.75**	0.02	0.05	<0.01	0.04	<0.01
Z) Bermuda grass	16.3	7.00/5.35	**0.63**	**1.56**	0.02	0.04	<0.01	0.03	<0.01
AA) citrus 1	200	56.3/29.5	**7.69**	**12.5**	**0.19**	0.32	<0.01	0.17	0.04
AB) sod farms	36.2	15.9/12.9	**1.39**	**3.53**	0.03	0.09	<0.01	0.08	<0.01
AC) golf courses	89.2	29.5/18.8	**3.43**	**6.58**	**0.09**	0.17	<0.01	0.11	0.02
AD) fire ants	82.7	36.3/29.4	**3.18**	**8.07**	**0.08**	0.21	<0.01	0.17	0.01
AE) roses	971	285/180	**37.3**	**63.3**	**0.92**	**1.64**	0.04	**1.06**	**0.17**
AF) ornamentals	1730	510/327	**66.5**	**113**	**1.64**	**2.93**	**0.07**	**1.92**	**0.31**
AG) Non-residential buildings	141	62.1/50.3	**5.42**	**13.8**	**0.13**	0.36	<0.01	0.30	0.03

Bold dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); **bold** orange-shaded RQs with an asterisk exceed only the listed species LOC (0.05) for acute risk.

[1] Acute RQ = Peak EEC (µg a.i./L)÷LC or EC_{50} (µg a.i./L); Chronic RQ = 21- or 60-day EEC (µg a.i./L)÷NOAEC (µg a.i./L); 21-d EEC for invertebrates and 60-d EEC for fish.

[2] Freshwater invertebrate LC_{50} = 26 µg a.i./L; NOAEC = 4.5 µg a.i./L (daphnid methamidophos toxicity data).

[3] Saltwater invertebrate LC_{50} = 1054 µg a.i./L; NOAEC = 174 µg a.i./L (mysid methamidophos toxicity data).

[4] Freshwater fish LC_{50} = 25,000 µg a.i./L; NOAEC = 170 µg a.i./L (rainbow trout methamidophos toxicity data).

[5] Saltwater fish LC_{50} = 5630 µg a.i./L (sheepshead minnow methamidophos toxicity data); NOAEC not available.

For freshwater invertebrates, all assessed uses except cranberry had acute LOC exceedances (with non-listed RQs ranging from 0.5 to 67), and only the listed species LOC (0.05) was exceeded for soybeans, celery, mint, tobacco and rights-of-way. Chronic LOCs were also exceeded for all uses except peppers (both bell and non-bell), cranberry, mint, tobacco, rights-of-way and alfalfa with RQs ranging from 1.0 to 113. The estuarine/marine invertebrate toxicity endpoints were less sensitive than those for freshwater invertebrates, and the only uses with both non-listed acute and chronic risk LOC exceedances were roses and ornamentals (acute RQs of 0.9 to 1.6, chronic RQs of 1.6 to 2.9); the Christmas tree, southern pine, citrus 1, golf course, fire ant, and non-residential buildings uses had listed-species acute LOC exceedances (RQs from 0.05 to 0.19).

RQ values for fish were lower than for invertebrates. Only the ornamental use exceeded the listed species LOC using freshwater fish data with an RQ of 0.07, and the chronic risk LOC was exceeded for roses and ornamentals with RQs of 1.1 to 1.9, respectively. Using the saltwater fish acute toxicity endpoint, which was more sensitive than freshwater, both roses and ornamentals had acute listed-species LOC exceedances with RQs of 0.17 and 0.31 respectively. No chronic fish data were available and no ACR was available for saltwater species—the ACR used for trout was from both a different chemical and a different taxa. Since saltwater acute toxicity data were more sensitive, some uncertainty exists for chronic risk to saltwater fish. However, rough screening calculations showed that if that ACR were applied to the saltwater acute data, no new uses would have had LOC exceedances.

Aquatic Plants

Table 32. Maximum Methamidophos RQ Values for Aquatic Plants from Acephate Uses.

Use Site	Peak EECs (µg a.i./L)	RQ[1]			
		Vascular Plants[2]		Non-vascular Plants[3]	
		Non-Listed	Listed	Non-Listed	Listed
All other outdoor uses	0-971	<0.01-0.47	<0.01-0.68	<0.01	<0.01-0.03
Ornamentals	1730	0.47	**1.21**	<0.01	0.06

Bold dark-pink-shaded RQs exceed the LOC (1.0).
[1] Non-Listed RQ = Peak EEC (µg a.i./L)÷ EC_{50} (µg a.i./L); Listed RQ = Peak EEC (µg a.i./L)÷NOAEC (µg a.i./L).
[2] Vascular Plant EC_{50} = 3650 µg a.i./L; NOAEC = 1420 µg a.i./L (duckweed methamidophos toxicity data).
[3] Non-vascular Plant EC_{50} = 679,000 µg a.i./L; NOAEC = 29,500 µg a.i./L (green algae methamidophos toxicity data).

The only LOC (1.0) exceedances for aquatic plants were for listed vascular plants from the ornamentals with an RQ of 1.2.

Terrestrial Organisms

Methamidophos is more toxic than acephate to birds (also surrogate for reptiles and terrestrial-phase amphibians) and mammals, but since it has a shorter half-life than acephate, calculations were made for both acephate and methamidophos to determine the most conservative RQ calculations for each feeding group – all results are presented in **Appendix H**. In this section, generally only the most conservative RQs from either acephate or methamidophos calculations are presented to simplify discussion.

Mammals, Birds, Reptiles and Terrestrial-Phase Amphibians

The highest RQs were from methamidophos calculations and are presented here (**Table 33** and **Table 34**) although LOC exceedances were also seen for birds and mammals with acephate calculations for all assessed uses.

Table 33. Avian Upper-bound Kenaga Nomogram RQs for Dietary- and Dose-based Exposures to Methamidophos from Acephate Use (Five Outdoor Use Patterns Selected to Include Highest, Lowest and Three Intermediate Application Rates).

Use (Type of Application) App Rate (lb a.i./A), # Apps, Interval (days)	Dietary Category	Avian Acute Dose-based RQs (mg/kg-bwt)			Avian Acute Dietary-based RQs (mg/kg-diet)	Avian Chronic Dietary-based RQs (mg/kg-diet)
		Sm. (20 g)	Med. (100 g)	Lg. (1000 g)		
Peppers, non-bell (aerial) 0.4, 2, 3	Short Grass	**35.5**	**15.9**	**5.04**	**3.95**	**55.2**
	Tall Grass	**16.3**	**7.29**	**2.31**	**1.81**	**25.3**
	Broadleaf plants	**20.0**	**8.95**	**2.84**	**2.22**	**31.1**
	Fruits/pods	**2.22**	**0.99**	**0.32***	**0.25***	**3.45**
	Arthropods	**13.9**	**6.23**	**1.98**	**1.55**	**21.6**
	Seeds	**0.49***	**0.22***	0.07	**0.25***	**3.45**
Celery/ mint (aerial) 0.8, 2, 3	Short Grass	**68.4**	**30.6**	**9.71**	**7.60**	**106**
	Tall Grass	**31.4**	**14.0**	**4.45**	**3.48**	**48.7**
	Broadleaf plants	**38.5**	**17.2**	**5.46**	**4.27**	**59.8**
	Fruits/pods	**4.27**	**1.91**	**0.61**	**0.47**	**6.65**
	Arthropods	**26.8**	**12.0**	**3.80**	**2.97**	**41.7**
	Seeds	**0.95**	**0.43***	**0.13***	**0.47***	**6.65**
Citrus (airblast) 3.1, 26, 7	Short Grass	**303**	**136**	**43.1**	**33.7**	**472**
	Tall Grass	**139**	**62.3**	**19.7**	**15.4**	**216**
	Broadleaf plants	**171**	**76.2**	**24.2**	**18.9**	**265**
	Fruits/pods	**19.0**	**8.49**	**2.69**	**2.10**	**29.5**
	Arthropods	**119**	**53.2**	**16.9**	**13.2**	**185**
	Seeds	**4.21**	**1.89**	**0.60**	**2.10**	**29.5**
Ornamentals (ground) 16.8, 26, 3	Short Grass	**3160**	**1410**	**448**	**351**	**4910**
	Tall Grass	**1450**	**648**	**205**	**161**	**2250**
	Broadleaf plants	**1780**	**795**	**252**	**197**	**2760**
	Fruits/pods	**197**	**88.4**	**28.0**	**21.9**	**307**
	Arthropods	**1240**	**554**	**176**	**137**	**1920**
	Seeds	**43.8**	**19.6**	**6.22**	**21.9**	**307**

Bold dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); bold orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.

All of the assessed outdoor uses had LOC exceedances for birds with RQs up to 4910, with the following exceptions:

- for use on non-bell peppers, only the listed species LOC (0.1) was exceeded for large (1000 g) birds feeding on fruits and pods, no exceedance was found for large birds feeding on seeds, and only the listed species LOC was exceeded for all other sizes (20g and 100g) feeding on seeds from dose-based data; and only the listed species LOC was exceeded for birds feeding on fruits, pods and seeds from dietary-based data; however, the dietary-based RQs exceeded the chronic risk LOC (with RQs from 3.5 to 55) for all groups; and,
- for the celery/mint/*etc*. use, only the listed species LOC was exceeded for medium and large birds feeding on seeds from dose-based data and all size classes from acute dietary-

based data; however, the dietary-based RQ value (RQ of 6.7) exceeded the chronic risk LOC for seed-consumers.

Table 34. Mammalian Upper-bound Kenaga Nomogram RQs for Dietary- and Dose-based Exposures to Methamidophos from Acephate Use (Five Outdoor Use Patterns Selected to Include Highest, Lowest and Three Intermediate Application Rates).

Use (Type of Application) App Rate (lb a.i./A), # Apps, Interval (days)	Dietary Category	Mammalian Dose-based RQs (mg/kg-bwt)						Mammalian Chronic Dietary-based RQs
		Small (15 g)		Med. (35 g)		Lg. (1000 g)		
		Acute	Chronic	Acute	Chronic	Acute	Chronic	
Peppers, non-bell (aerial) 0.4, 2, 3	Short Grass	**0.51**	**37.0**	**0.44***	**31.6**	**0.23***	**16.9**	**4.26**
	Tall Grass	**0.23***	**17.0**	**0.20***	**14.5**	**0.11***	**7.76**	**1.95**
	Broadleaf plants	**0.29***	**20.8**	**0.25***	**17.8**	**0.13***	**9.52**	**2.40**
	Fruits/pods	0.03	**2.31**	0.03	**1.97**	0.01	**1.06**	0.27
	Arthropods	**0.20***	**14.5**	**0.17***	**12.4**	0.09	**6.63**	**1.67**
	Seeds	0.01	0.51	0.01	0.44	<0.01	0.24	0.27
Celery/ mint (aerial) 0.8, 2, 3	Short Grass	**8.87**	**277**	**7.58**	**236**	**4.06**	**127**	**31.9**
	Tall Grass	**4.07**	**127**	**3.47**	**108**	**1.86**	**58.1**	**14.6**
	Broadleaf plants	**4.99**	**156**	**4.26**	**133**	**2.28**	**71.3**	**17.9**
	Fruits/pods	**0.55**	**17.3**	**0.47***	**14.8**	**0.25***	**7.92**	**1.99**
	Arthropods	**3.47**	**108**	**2.97**	**92.6**	**1.59**	**49.6**	**12.5**
	Seeds	**0.12***	**3.84**	**0.11***	**3.28**	0.06	**1.76**	**1.99**
Citrus (airblast) 3.1, 26, 7	Short Grass	**39.3**	**1230**	**33.6**	**1050**	**18.0**	**562**	**141**
	Tall Grass	**18.0**	**563**	**15.4**	**480**	**8.26**	**258**	**64.8**
	Broadleaf plants	**22.1**	**690**	**18.9**	**590**	**10.1**	**316**	**80.0**
	Fruits/pods	**2.46**	**76.70**	**2.10**	**65.5**	**1.13**	**35.1**	**8.84**
	Arthropods	**15.4**	**481**	**13.2**	**411**	**7.05**	**220**	**55.4**
	Seeds	**0.55**	**17.1**	**0.47***	**14.6**	**0.25***	**7.80**	**8.84**
Ornamentals (ground) 16.8 26, 3	Short Grass	**409**	**12800**	**350**	**10900**	**187**	**5850**	**1470**
	Tall Grass	**188**	**5850**	**160**	**5000**	**85.9**	**2680**	**675**
	Broadleaf plants	**230**	**7190**	**197**	**6140**	**105**	**3290**	**828**
	Fruits/pods	**25.6**	**798**	**21.9**	**682**	**11.7**	**366**	**92.0**
	Arthropods	**160**	**5000**	**137**	**4270**	**73.4**	**2290**	**577**
	Seeds	**5.69**	**177**	**4.86**	**152**	**2.60**	**81.2**	**92.0**

Bold dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); bold orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.

All outdoor uses had LOC exceedances for mammals for all assessed uses with RQs up to 12,800, with the following exceptions:

- for use on non-bell peppers, no exceedances were found for seed consumers; only chronic LOCs (1.0) were exceeded for fruit and pod consumers from dose-based data; for all other feeding groups, chronic LOCs were exceeded from both dose-based and dietary-based data and acute listed species LOCs (0.1) were exceeded for all size classes from dose-based data except large arthropod consumers; also for small (15g) short grass consumers, the acute non-listed LOC (0.5) was also exceeded;
- for the celery/mint/*etc.* use, all LOCs were exceeded with the exceptions that for consumers of fruits and pods, medium (35g) and large (1000g) mammal acute LOC exceedances were only found for the listed species LOC from dose-based RQ values and for seed consumers, small and medium mammal acute LOC exceedances were only found for the listed species LOC and none for large mammals from dose-based data; however, for all these groups, chronic LOCs were exceeded from both dose-based and dietary-based data (with RQs from 1.8 to 277); and
- for the citrus use, all LOCs were exceeded with the exception that only the listed species LOC was exceeded based on acute dose-based data for medium and large seed-consumers; for all other consumers both acute and chronic RQs were exceeded with RQs as high as 1230.

Table 35. LD_{50}/ft^2 Values Derived Using T-REX for Methamidophos

Use (Application Rate: acephate/methamidophos adjustment)	Application Type	LD_{50} Per Square Foot at Application Site					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Cotton (1 lb a.i./A / 0.77 lb a.i./A)	Soil in-furrow, granular (or liquid)	377	59.3	4.2	78.0	41.3	3.3
Golf Course Turf (4.77 lb a.i./A / 3.61 lb a.i./A)	Broadcast, granular	360	56.5	4.0	74.3	39.4	3.2
Beans / cranberry / cauliflower / celery / lettuce / mint / peanuts (1 lb a.i./A / 0.77 lb a.i./A)	Broadcast, granular	75.5	11.9	0.8	15.6	8.3	0.7

The LD_{50}/ft^2 analysis showed potential toxicity at application sites for all assessed uses based on both acephate and methamidophos exposure for all size classes of birds and mammals with up to 377 times the LD_{50} in each ft^2 of treated area for birds and 78 for mammals (**Table 35**, for LD_{50}/ft^2 based on acephate exposure, see **Appendix H**).

Table 36. Acute and Chronic Seed Treatment RQs Derived Using T-REX Based on Methamidophos Exposure.

Use (Application Rate)	RQs for Birds and Mammals Consuming Treated Seeds*						Chronic Dietary Based RQs[3]
	Acute Based on Dose vs. Max. Seed App. Rate[1]			Acute Based on Dose vs. Available Pesticide/sq. Ft[2]			
	S	M	L	S	M	L	
Birds							
Cotton (0.320 lbs a.i./cwt)	**122**	**55**	**17**	**4.8**	**0.75**	<0.1	**855**
Peanuts (0.197 lb a.i./cwt)	**75**	**34**	**11**	**35**	**5.6**	**0.39***	**527**
Mammals							
Cotton (0.320 lbs a.i./cwt)	**15.8**	**14**	**7.3**	**0.98**	**0.52**	<0.1	**494**
Peanuts (0.197 lb a.i./cwt)	**9.8**	**8.4**	**4.5**	**7.3**	**3.9**	**0.31***	**305**

S = Small (20g for birds, 15g for mammals); M = Medium (100g for birds, 35g for mammals); L = Large (1000g for birds and mammals). **Bold** dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); **bold** orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.

[1] Based on EEC calculated for each size class by TREX from maximum seed application rate (2464 mg ai/kg seed for cotton and 1581 mg ai/kg seed for peanuts) and acute oral toxicity values (grackle LD_{50} = 6.7 mg/kg-bw; rat LD_{50} = 15.6 mg/kg-bw).

[2] Based on EEC per sq. ft from TREX calculations and acute oral toxicity values (grackle LD_{50} = 6.7 mg/kg-bw; rat LD_{50} = 15.6 mg/kg-bw).

[3] Based on dietary-based EEC and Mallard duck NOAEC = 3 mg/kg-diet.

Both cotton and peanut seed treatments had RQ values which exceeded the acute risk LOC for small and medium birds and mammals feeding on seeds based on both acephate and methamidophos modelling (with RQs as high as 122), and for all size classes when based on methamidophos modeling; chronic dietary RQs were also exceeded for both birds and mammals with RQs as high as 885 (**Table 36,** for acephate RQs see **Appendix H**).

Risk was also calculated for birds and mammals from the number of treated seeds consumed based on methamidophos consumption (**Table 37** and **Table 38**, see **Appendix H** for calculations based on acephate consumption).

Table 37. Calculations of Exposure from Treated-Seed Consumption Based on Test Organism Weights.

Crop	lb a.i./cwt[1]	# seeds / lb-seed[2]	mg ai/seed[3]	LD_{50}, mg ai/kg-bw	Study	Bw of test org, kg	mg ai for LD_{50}[4]	1 seed RQ[5]	# seeds for LD_{50}[6]
Based on Methamidophos									
Cotton	0.246	4500	0.248	6.7	Grackle	0.094	0.630	0.39	**2.54**
Peanuts	0.152	907	0.760	15.6	Rat	0.35	5.46	0.14	**7.18**

[1] From TREX; cwt – hundredweight (100 lbs seed).

[2] From Table B-1., pp. 81- of Becker and Ratnayake (2011); for peanuts used the most recently cited value (907).

[3] Calculation: lb ai/cwt * cwt/100 lb-seed ÷ # seeds/lb-seed * 453592 mg/lb = mg ai/seed.

[4] Calculation: LD50 in mg ai/kg-bw * kg-bw (of test organism) = mg ai to reach LD_{50} in test organism.

[5] Calculation: mg ai/seed ÷ mg ai for LD_{50} = RQ estimate for consumption of one seed.

[6] Calculation: mg ai for LD_{50} ÷ mg ai/seed = # seeds needed to be consumed to reach LD_{50}.

Based on the weights of test organisms from endpoints used for RQ calculations, the consumption of a single treated seed would be below the LOC (with RQs of 0.14-0.39) for both cotton and peanuts. However, consumption of 2.5 treated cotton seeds would be equivalent to the LD_{50} of methamidaphos for the grackle and consumption of 7.2 seeds would exceed the methamidaphos LD_{50} for the rat (see **Appendix H** for calculations based on acephate).

Table 38. Risk Quotients for Birds and Mammals from Treated-Seed Consumption.

Seed Treatment	Bird and Mammal Size Classes					
	Small Bird 20g	**Medium Bird 100 g**	**Large Bird 1000g**	**Small Mammal 15g**	**Medium Mammal 35g**	**Large Mammal 1000g**
Based on Methamidophos						
Adjusted LD_{50} For Each Size Class						
LD_{50}, mg/kg-bw[1]	5.31	6.76	9.55	34.3	27.7	12.0
Number of Seeds Needed to Be Consumed to Reach LD_{50}[2]						
Cotton	**0.43**	**2.73**	**38.5**	**2.07**	**3.92**	**48.4**
Peanuts	**0.14**	**0.89**	**12.6**	**0.68**	**1.28**	**15.8**

[1] From TREX.
[2] Calculation: Adjusted LD_{50} mg ai/kg-bw * kg-bw (size class in g ÷1000) ÷ mg ai/seed = # seeds needed to reach LD_{50}.

Calculations were also made to determine the number of treated seeds that would need to be consumed to exceed an adjusted LD_{50} for each of the standard size classes of birds and mammals (size classes from TREX). Less than half of one cotton seed or one fourth of one peanut would exceed the LD_{50} for small birds. Values range to 48 treated cotton seeds or 16 treated peanuts to reach the LD_{50} of a large (1000g) mammal.

Terrestrial Invertebrates

Risk was calculated using both honeybee and other insect data; for acephate toxicity the endpoint used was from Soybean looper larvae and for methadidophos toxicity from Western spruce budworm larvae toxicity data. Budworm data was the most sensitive, but acephate was slightly more toxic than methamidophos to the honeybee. Since all uses exceeded the LOC, only the highest calculations are presented here (**Table 39**) but calculations based on both compounds are presented in **Appendix H**.

Table 39. RQs for Terrestrial Invertebrates Based on Acephate and Methamidophos Exposure.

Use [Method of Application, Application Rate (lbs a.i./acre), # of app, App interval (days)]	Acephate EEC[1] for honeybee (ug a.i./bee)	RQ (based on honey bee data)[2]	Methamidophos EEC[3] for small insect (µg a.i./g)	RQ (based on budworm data)[4]
Peppers, non-bell [aerial, 0.5, 2, 3]	1.4	**1.1**	64.9	**8.7**
Celery/mint [aerial, 1.0, 2, 3]	2.7	**2.3**	125	**16.8**
Citrus [airblast, 4.0, 26, 7]	10.8	**9.0**	554	**74**
Ornamentals [ground, 21.8, 26, 3]	58.9	**49.1**	5770	**774**

Bold dark-pink-shaded RQs exceed the LOC (0.4 for acute risk).
[1] Based on new guidance (USEPA, 2014);[14] calculation for Tier I contact toxicity – Application Rate (in lb a.i./A)*2.7 = EEC (in ug a.i./bee).
[2] Based on honey bee toxicity endpoint: RQ = EEC/LD_{50} (LD_{50} of 1.20 ug a.i./bee).
[3] Small insect EEC from TREX.
[4] Based on Western spruce budworm larvae toxicity endpoint for methamidophos: RQ = EEC/LD_{50} (7.45 µg a.i./g of larvae).

Using honey bee toxicity data, all assessed uses produced LOC (LOC = 0.4) exceedances using the newly published Tier I screening guidance (with RQs from 1.1 to 49.1). Using Spruce budworm methamidophos toxicity data, with TREX estimates, all assessed uses produced LOC exceedances with RQs from 9 to 774 (**Table 39**), see **Appendix H** for full acephate and methamidophos RQs. Additional data on pollinators are also needed to fully characterize the risk to all developmental stages of honey bees, as sensitivity may vary according to life-stage and length of exposure (adult vs. larval and acute vs. chronic, respectively). These data are required under the Guidance for Assessing Pesticide Risks to Bees (USEPA et al., 2014).

Terrestrial Plants

The only LOC (1.0) exceedances for plants were from the ornamentals, roses, and non-residential building uses. Listed monocots and dicots inhabiting semi-aquatic areas had RQs above the LOC when risk was assessed based on either acephate (RQ's from 1.3 to 2.8) or methamidophos (RQ's from 0.99 to 2.1) exposure and toxicity (**Table 40**). Risk to non-listed plants in semi-aquatic areas could not be precluded based on a non-definitive (*i.e.*, > greater-than) endpoint. Since this assessed risk was due to a lack of toxicity information at the maximum application rates (*i.e.*, 21.8 lbs acephate/A or 16.8 lb methamidophos/A), the actual risk is uncertain, but cannot be precluded without data showing that the no-effects level is above the maximum application rate.

[14] http://www2.epa.gov/sites/production/files/2014-6/documents/pollinator_risk_assessment_guidance_06_19_14.pdf

Table 40. RQs for Terrestrial Monocot and Dicot Plants Inhabiting Dry and Semi-aquatic Areas Exposed to Acephate via Runoff and Drift.

Application Rate (Crop)	Spray drift		Dry area		Semi-aquatic area	
	Non-Listed Species RQ[1]	Listed Species RQ[2]	Non-Listed Species RQ[1]	Listed Species RQ[2]	Non-Listed Species RQ[1]	Listed Species RQ[2]
Foliar Aerial and Airblast Applications – based on either acephate or methamidophos exposure and toxicity						
Peppers, non-bell – based on acephate or methamidophos	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Celery – based on acephate	<0.10	<0.10	<0.10	<0.10	<0.14	0.14
Celery – based on methamidophos	<0.10	<0.10	<0.10	<0.10	<0.11	0.11
Citrus – based on acephate	<0.10	<0.10	<0.10	0.10	<0.56	0.56
Citrus – based on methamidophos	<0.10	<0.10	<0.10	<0.10	<0.43	0.43
Foliar Ground Applications and Spot Treatments						
Golf course turf – based on acephate	<0.10	<0.10	<0.10	<0.10	<0.61	0.61
Golf course turf – based on methamidophos	<0.10	<0.10	<0.10	<0.10	<0.47	0.47
Fire Ants– based on acephate	<0.10	<0.10	<0.10	<0.10	<0.88	0.88
Fire Ants– based on methamidophos	<0.10	<0.10	<0.10	<0.10	<0.67	0.67
Non-residential buildings– based on acephate	<0.10	<0.10	<0.15	0.15	**<1.30**	**1.30**
Non-res. build.– based on methamidophos	<0.10	<0.10	<0.12	0.12	<0.99	0.99
Roses– based on acephate	<0.10	<0.10	<0.24	0.24	**<2.05**	**2.05**
Roses– based on methamidophos	<0.10	<0.10	<0.18	0.18	**<1.56**	**1.56**
Ornamentals - based on acephate	<0.10	<0.10	<0.33	0.33	**<2.81**	**2.81**
Ornamentals - based on methamidophos	<0.10	<0.10	<0.25	0.25	**<2.14**	**2.14**

Bold values exceed the terrestrial plant LOC of 1.0.

[1] Non-listed Plant species RQ = (EEC) / EC_{25}

[2] Listed Plant species RQ = (EEC) / NOAEC (EC_{05})

5.2. Risk Description

Risks to Aquatic Organisms

Exposures to acephate residues of concern (acephate and methamidophos) resulted in RQ values that exceeded both non-listed acute and chronic risk LOCs (0.5 and 1.0, respectfully) for aquatic invertebrates in 21 out of 30 outdoor use groups assessed (with RQs up to 67 for acute risk and 113 for chronic risk, **Table 31,**

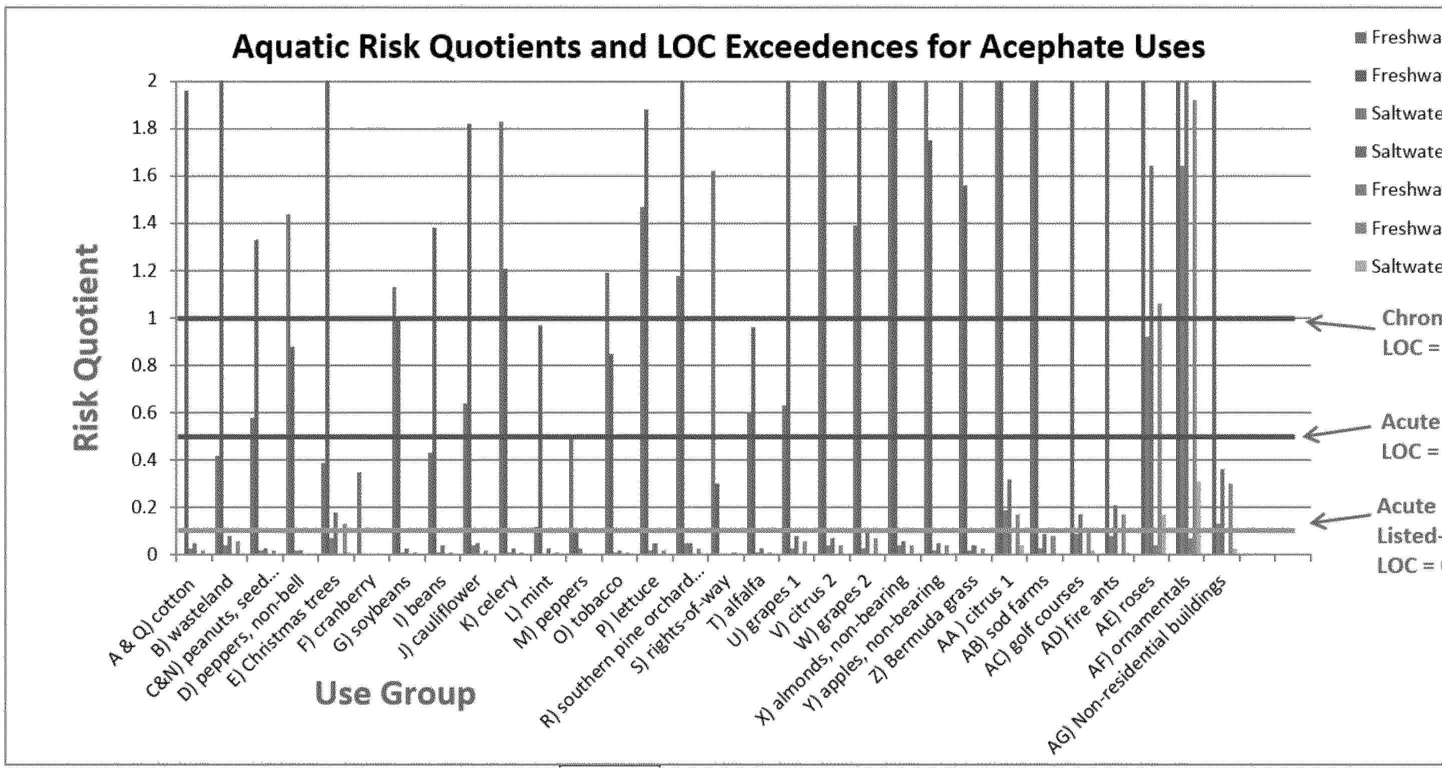


Figure 3); an additional three more uses (bell and non-bell peppers and alfalfa) had acute non-listed LOC exceedances; two more (soybeans and celery) had chronic LOC exceedances and listed-species exceedances (LOC of 0.05); and three more had acute listed-species LOC exceedances (mint, tobacco and rights-of-way). The only use without an LOC exceedance was cranberry; this was because cranberry use had negligible exposure since it would have degraded below toxic thresholds between the times of application and release of water from the cranberry bog after harvest. Saltwater invertebrates were less sensitive and only two use groups exceeded both acute and chronic LOCs, and six additional use groups exceeded the listed-species LOC. Fish were also less sensitive, with only two use groups having acute listed-species (based on saltwater fish acute toxicity data) and chronic LOC exceedances; only one of these uses had a listed-species acute LOC exceedance based on freshwater fish acute toxicity data The threeuse groups with the highest RQ values, in general for aquatic animals were roses, ornamentals, and non-residential buildings.

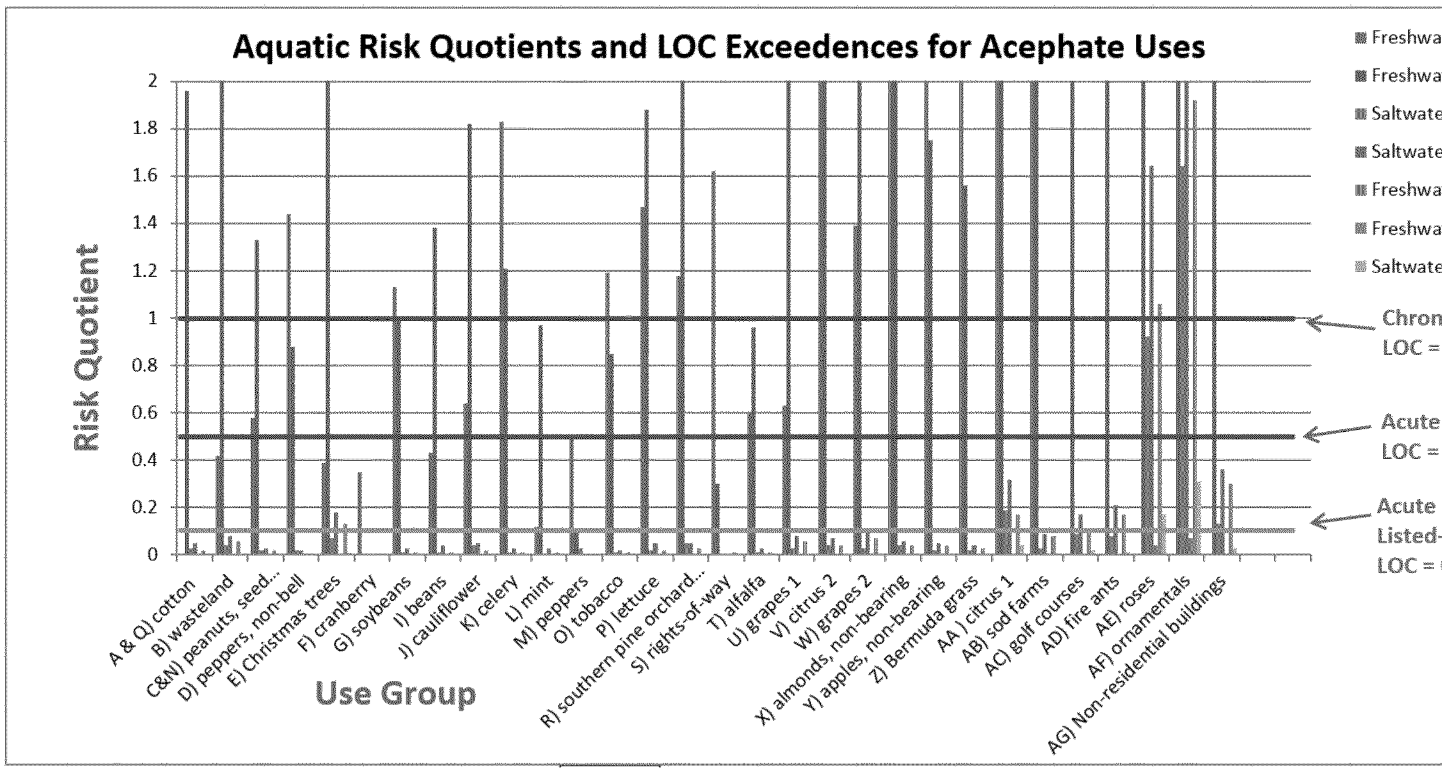


Figure 3 emphasizes the numerous LOC exceedances and others that were near the LOC bars shown in red (acute and chronic non-listed) and yellow (acute listed-species). Please note that the chart only goes up to an RQ level of 2.0 and does not show the extent of exceedances for the higher RQs, which were as high as 67 for acute and 113 for chronic risk.

RQ values for aquatic plants were lower than for aquatic animals. Available toxicity data did not show toxicity at the highest concentration tested for either vascular or non-vascular aquatic plants. A single exceedance was found for listed vascular plant species with an RQ of 1.2; however, the RQ value was based on an aquatic plant toxicity study that did not produce an effect, but the highest concentration was not sufficient to cover the exposure calculated from the ornamentals use. No other RQ value exceeded the LOC.

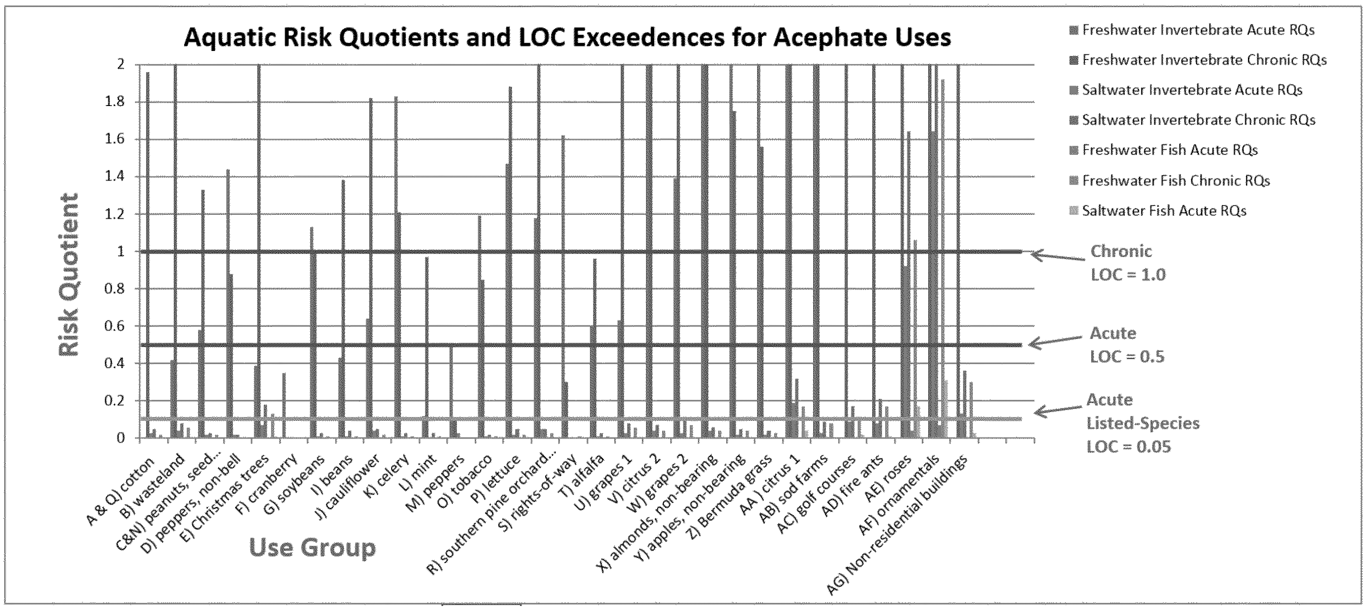


Figure 3. Risk Quotients showing Level-of-Concern Exceedances for Most of the Grouped Registered Uses of Acephate.

Additional Characterization of Non-residential Buildings and Other Non-Food Uses

The aquatic exposure for the non-food uses are, in general, considerably higher than those for the food uses. This is due, in part, to higher single application rates and also, in part, due to conservative assumptions which are made regarding the number of applications and the intervals between them, namely 26 applications, with application made every 3 days. These assumptions are routinely made when the labels do not specify a maxium number of applications or seasonal application rate and no minimum interval is specified. In addition, for the perimeter treatment around non-residential buildings, there are likely to be less than less buildings treated than the ten assumed in the assessment. While these values are occasionally equaled or exceeded for some crops and use patterns, the actual use pattern for acephate on non-residential buildings is likely to be much less.

When doing alternative analyses for application practices, it is useful to have actual usage data to support the assessment. For this application, this information is not available. Alternatively, we can make reasonable assumptions based on rates from other labels and general practices used for application to commercial premises. For the application rate, we can use a single application rate based on the lower of the two application rates found on other labels, 0.073 lb/gal. Based on the calculation described in the usage section above, this is equivalent to 10.16 lb/acre. For the number of applications, we can assume 1 per year and 4 per year; 4 applications per year is the typical number made by commercial applicators to home lawns. Since it is not clear how prevalent this application practice is, we can also make an application assuming only 1 building in the watershed is treated. For aquatic assessments, the watershed is 10 hectares, or 24.7 acres, so the effective application rate to the watershed would be 10.16/24.7 = 0.41 lb/acre.

Table 41. Comparison of Use Patterns for Acephate Used on Non-Residential Buildings

	1-in-10 Year EECs ($\mu g \cdot L^{-1}$)		
Use Pattern	**Peak**	**21 Day Mean**	**60 Mean**
0.073 lb/gal, 26x 3-day interval	159	70.1	56.8
0.073 lb/gal, 4x, monthly	59.4	12.2	7.14
0.073 lb.gal, 1x	35.3	9.33	3.31
0.07, 1x, 1 building	1.43	0.38	0.13

EECs decreased by a factor of 15.9 times going from 1.16 lb/gal to 0.073 lb/gal and another factor to 2.7 when the number of applications is reduced to 4 with monthly applications rather than every 3 d. However, these EECs still exceed the acute and chronic LOCs for aquatic invertebrates. In addition to the changes in use pattern, an EEC assuming that there is only one treated building in the watershed was made. This EEC is below the level of concern for all aquatic life; the lowest toxicity values are 26 $\mu g \cdot L^{-1}$ for acute and 4.2 for chronic effects. This indicates that these very large EECs are largely due to the very high label application rate, and that the standard application assumptions in the absence of limits on number of applications and application interval are a significant but secondary factor. The fraction of the total area (the number of buildings) in the watershed may also be important. For example, if a commercial applicator treated all the buildings in an industrial park on the same day, this would lead to risks more like the *all buildings treated* scenarios (top 4 lines in **Table 42**) as compared to the *single building treated* scenario (bottom line in **Table 42**). The likelihood of this scenario is unknown.

In addition to the perimeter treatment around commercial buildings, the other non-food uses have, in general, higher rates than those for the food uses, which are mostly 1 $lb \cdot acre^{-1}$ or less. These uses are tabulated in **Table 42** below. Most of these uses have rates which are expressed as both pounds per hundred gallons of spray and pound per acre. The lists both the highest and lowest rate for each type for each non-food use.

Table 42. Comparison of Use Patterns for Acephate Used on Non-Food Use Sites.

Use Pattern	Per Gallon Rates (lb/acre equivalents in parentheses)		Per Acre Rates	
	Highest	Lowest	Highest	Lowest
golf course	--	--	4.77	1.3
nursery stock	0.0075 (16.3)	0.0049 (10.7)	5	0.567
ornamental trees	0.01 (21.8)	.00125 (2.7)	1	--
ornamental ground cover	0.01 (21.8)	.0045 (9.81)	1	--
ornamental herbaceous plants	0.01 (21.8)	0.0025 (5.45)	1	-
ornamental. non-flowering plants	0.01 (21.8)	.0045 (9.91)	1	-
sod farm	--	--	3	2.5
shrubs	0.01 (21.8)	0.0025 (5.45)	1	0.45
roses	0.0075 (16.3)	0.0045 (9.81)	15.0	0.5

* This use is a spot treatment, so the rate used in assessment was half this rate to reflect the most that would be applied as a spot treatment.

The golf course and sod farm uses have only a 'per acre' rate. All the ornamental uses have a 1 lb / 100 gal rate, which is equivalent to 21.8 lb per acre based on 2 mm depth assumption described in the Use section above. For those uses with both rates, even the lowest per gallon rates are higher than the highest per acre rates, though for roses, the rates are very similar – 16.3 versus 15.0. The per acre rate for ornamentals is 1 $lb \cdot acre^{-1}$ for all groups accept sod farms, where it is 3 $lb \cdot acre^{-1}$. The 5 $lb \cdot acre^{-1}$ rate for nursery stock is specifically for container and bed grown plants in green houses and nurseries. For this use, it is unlikely that the full 5 $lb \cdot acre^{-1}$ would be applied to the full Standard Pond watershed as there is always spacing between the beds in nurseries.

To demonstrate how exposure changes with application practices for the other non-food uses, the 1 $lb \cdot acre^{-1}$ was simulated with 26 applications per year, 4 applications per year, and 1 app-lication per year. The results of these simulations is in **Table 43**. Decreasing the application rate from 21.8 to 1 $lb \cdot acre^{-1}$ decreases the EECs by over an order of magnitude while decreasing the number of applications to 1 per year decrease the peak EEC by somewhat more than a factor of 3.

Table 43. Comparison of Use Patterns for Acephate Used on Non-Food Uses.

	1-in-10 Year EECs ($\mu g \cdot L^{-1}$)		
Use Pattern	**Peak**	**21 Day Mean**	**60 Mean**
21.8 lb/acre, 26x 3-day interval	1730	510	327
1 lb/acre, 26x 3-day interval	79.3	23.4	15.0
1 lb/acre, 4x, monthly	53.7	9.35	4.24
1 lb/acre, 1x	24.7	4.51	2.13

Risks to Terrestrial Organisms

Terrestrial animals had LOC exceedances from all uses of acephate with RQ values exceeding LOCs by several orders of magnitude for some uses (**Figure 4**).

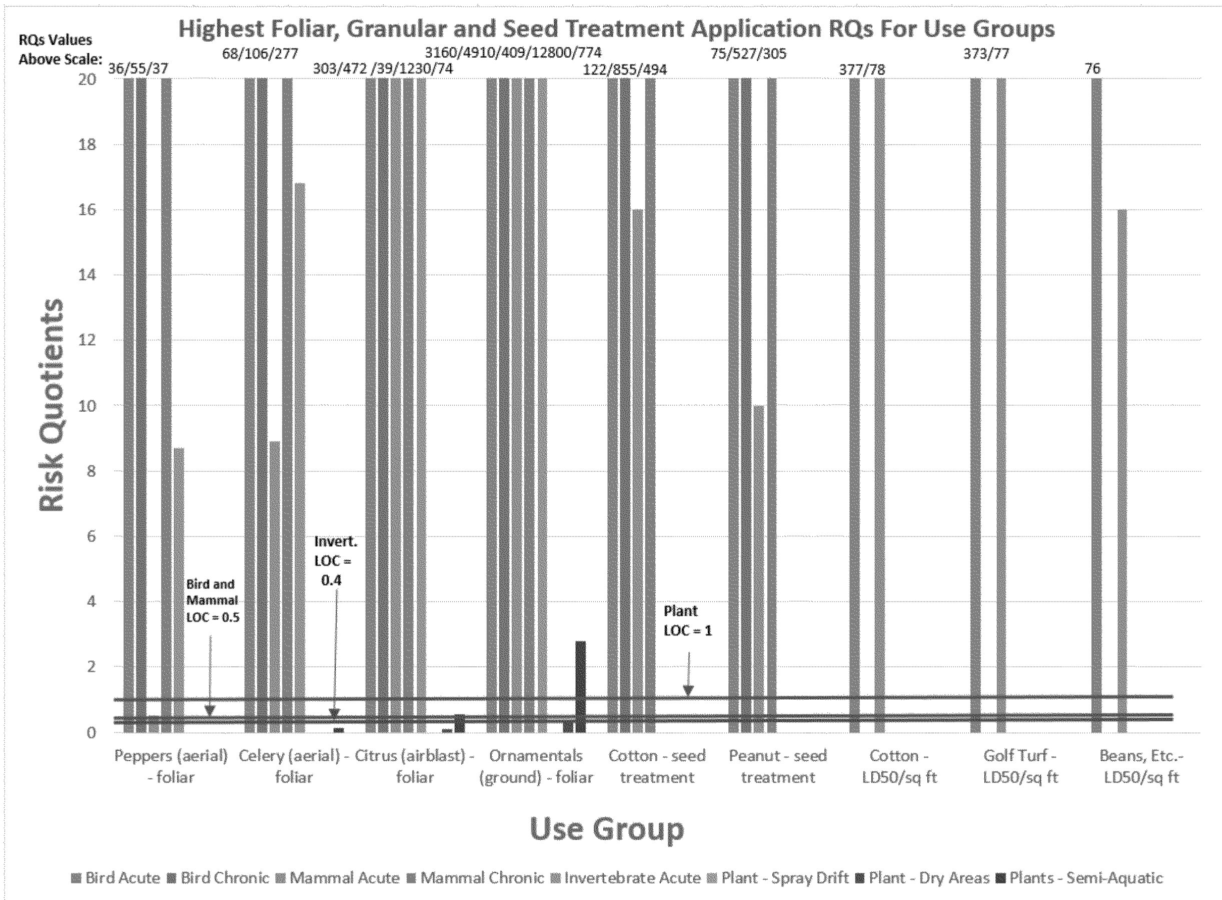


Figure 4. Risk Quotients showing Level-of-Concern Exceedances for All of the Grouped Registered Uses of Acephate from Foliar Applications.

The foliar applications were analyzed by assembling uses into four groups, representing high, low and two intermediate use rates (see **Section 3.5**). The first group was the non-bell peppers group, representing the following uses: B) wasteland, non-bell peppers, M2) rights-of-way and T) Christmas trees (with single application rates ranging from 0.25 to 0.5 lb a.i./A). These uses had the lowest use rates and were analyzed using the non-bell peppers application rate (0.5 lb a.i./A) as the representative. Even though two other uses within this group had single application rates that were slightly lower (wasteland and rights-of-way had single application rates of 0.248-0.25 lb a.i./A), they did not limit applications to only 2, but allowed an estimated 26 applications annually and so for bird, mammal and insect calculations would not have had the lowest EEC's; their single application rates were of the same order-of–magnitude as non-bell peppers. Since plant RQs are calculated based on a single application, these two uses would have resulted in slightly lower plant RQs but this did not affect the results since this group of uses did not have plant LOC exceedances. This group had LOC exceedances for birds, mammals and terrestrial invertebrates—all animal taxa, but not plants.

The second group was the celery use group which included: F) cranberry, G) soybeans, I) beans, J) cauliflower, K) celery,L) mint, M) bell peppers, N) peanuts, O) tobacco, P) lettuce, Q) cotton, T) alfalfa, U) grapes 1, V) citrus 2, W) grapes 2, X) almonds, non-bearing, Y) apples, non-bearing and Z) Bermuda grass. These were the lowest-intermediate use rates (with single application rates ranging from 0.73 to 1.1 lb a.i./A) and were analyzed using the celery application rate (1 lb a.i./A) as the representative. All use rates in this grouping were very similar. This group had LOC exceedances for all animal taxa, but not plants.

The third group was the citrus use group which included: R) southern pine orchard seedlings, AA) citrus 1, AB) sod farms, AC) golf course turf, and AC) fire ants. These were the highest-intermediate use rates (with single application rates ranging from 3 to 6.8 lb a.i./A) and were analyzed using the higher citrus application rate as the representative. Even though some use rates were higher and some lower in this grouping, they were of the same order-of-magnitude, the citrus rate being an approximate median rate (4 lb a.i./A). This group also had LOC exceedances for all animal taxa, but not plants.

The fourth group was the ornamentals use group and included: AE) roses, AF) ornamentals, and AG) non-residential buildings. These were the highest use rates (with single application rates ranging from 10.1 to 21.8 lb a.i./A) analyzed using the ornamentals application rate (21.8 lb a.i./A) as the representative. For non-residential buildings, this was a spot treatment and so exposure would be expected to be less than a broadcast spray, but difficult to quantify. I Even though the rose application rate was lower than ornamentals, it was of the same order-of-magnitude and, therefore, ornamentals was the highest chosen to see the full range of risk calculations.

Cotton and peanut seed treatments had both acute and chronic LOC exceedences, with chronic bird RQ's as high as 855 and 527, respectively for cotton and peanuts and chronic mammal RQ's as high as 494 and 305. Less than half of one cotton seed or one fourth of one peanut would exceed the LD_{50} for small birds. Values range to 48 cotton seeds or 16 peanuts to reach the LD_{50} of a large (1000g) mammal.

For granular uses, all uses showed the potential at application sites for acute toxicity based on LD_{50}/ft^2 with the exception that for the beans, etc. use, for the largest size class of mammals (1000g), only 0.7 of the LD_{50} (or 70%) would be present in one square foot, but two square feet would contain sufficient toxicity to match the LD_{50} estimate. The granular uses that apply included cotton, golf course turf, beans, peppers, Brussels sprouts, cauliflower, celery, citrus, lettuce, mint and peanuts.

Overall, for animals, even the lowest application rate exceeded both acute and chronic LOCs for at least some size classes/feeding groups of both birds and mammals. The largest group (represented by the celery use) also exceeded LOCs for most size and feeding classes of birds and mammals if calculated based on a single application (those data are not presented here, but RQs for birds ranged from 0.08 to 61 and for mammals from 0.03 to 160). Seed treatment and granular uses showed similar LOC exceedances.

As with aquatic plants, RQ values for terrestrial plants were far less than for animals. Overall, for plants, available toxicity data did not show toxicity at the highest treatment level for any of the ten terrestrial plant species tested and only the highest application rates had potential LOC exceedances. For ornamentals, plants in semi-aquatic areas had listed species LOC exceedances (RQ of 2.8), and the non-listed species LOC exceedance could not be precluded since the toxicity test data did not cover that application rate, resulting in a calculation using a non-definitive (>, greater than) endpoint.

The newly released guidance for assessing pesticide risks to bees (USEPA, 2014) recommends further testing, including a study to determine the toxicity of residues on foliage to honey bees (OCSPP 850.3030).

5.3. Listed Species

In November 2013, the EPA, along with the U.S. Fish & Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS) (collectively, the Services), and the U.S. Department of Agriculture (USDA) released a summary of their joint Interim Approaches for assessing risks to listed species from pesticides. The Interim Approaches were developed jointly by the agencies in response to the National Academy of Sciences' (NAS) recommendations and reflect a common approach to risk assessment shared by the agencies as a way of addressing scientific differences between the EPA and the Services. The NAS report outlines recommendations on specific scientific and technical issues related to the development of pesticide risk assessments that EPA and the Services must conduct in connection with their obligations under the Endangered Species Act (ESA) and FIFRA.

The joint Interim Approaches were released prior to a stakeholder workshop held on November 15, 2013. In addition, the EPA presented the joint Interim Approaches at the December 2013 Pesticide Program Dialogue Committee (PPDC) and State-FIFRA Issues Research and Evaluation Group (SFIREG) meetings, and held stakeholder workshops in April 2014, allowing additional opportunities for stakeholders to comment on the Interim Approaches. As part of a phased, iterative process for developing the Interim Approaches, the agencies will also consider public comments on the Interim Approaches in connection with the development of upcoming Registration Review decisions. The details of the joint Interim Approaches are contained in the white paper "Interim Approaches for National-Level Pesticide Endangered Species Act Assessments Based on the Recommendations of the National Academy of Sciences April 2013 Report," dated November 1, 2013.

Given that the agencies are continuing to develop and work toward implementation of the Interim Approaches to assess the potential risks of pesticides to listed species and their designated critical habitat, this preliminary risk assessment for acephate does not contain a complete ESA analysis that includes effects determinations for specific listed species or designated critical habitat. Although EPA has not yet completed effects determinations for specific species or habitats, for this preliminary assessment EPA conducted a screening-level assessment for all taxa of non-target wildlife and plants that assumes for the sake of the assessment that listed species and designated critical habitats may be present in the vicinity of the application of acephate. This screening level assessment will allow EPA to focus its future evaluations on the types of species where the potential for effects exists once the scientific methods being developed by the agencies have been fully vetted. This screening-level risk assessment for acephate indicates potential risks of direct effects to listed species from all taxanomic groups on at least some of its registered use sites. Listed species of all animal taxa may also be affected through indirect effects because of the potential for direct effects on listed and non-listed species upon which such species may rely. Potential direct effects on listed species from the use of acephate may be associated with modification of Primary Constituent Elements (PCEs) of designated critical habitats, where such designations have been made. Once the agencies have fully developed and implemented the scientific methods necessary to complete risk assessments for endangered and threatened (listed) species and their designated critical habitats, these methods will be applied to subsequent analyses for acephate as part of completing this registration review.

5.4. Risk Conclusions

Birds (also surrogate for reptiles and terrestrial-phase amphibians) and mammals had risk level of concern (LOC) exceedances for all foliar uses of acephate, with RQs in the tens and hundreds for agricultural uses and hundreds and thousands for ornamental uses. Acute LOCs were exceeded for birds and mammals consuming seeds, even with as little as a single treated seed. Numerous bird incidents are associated with acephate and/or methamidophos exposure; methamidophos has been identified in bird tissues in two incidents. Terrestrial invertebrates have similar RQs to those of birds and mammals and bee-kill incidents have been associated with acephate and/or methamidophos exposure. Aquatic invertebrates have RQs as high as 67, with exceedances from most uses; fish have RQs as high as 2 with exceedances only from roses and ornamentals); the highest rates for fish and aquatic invertebrates are based on high application rate allowances as well as conservative assumptions, but exceedances for aquatic invertebrates were also found in most of the agricultural uses. Risks to plants did not exceed the LOC for most uses based on spray drift analyses, but incident reports suggest that plants present in treated areas can be damaged by acephate use, though causality was uncertain for incidents involving products still registered.

Label uncertainties were identified in earlier risk assessments (*e.g.*, USEPA, 2009).

Though the toxicity and fate datasets are relatively complete, some uncertainties still exist. The greatest is for chronic toxicity to fish. The acute-to-chronic ratio was derived from another similarly structured compound (dichlorvos) which may be a reasonable estimate. However, the estuarine/marine fish acute toxicity endpoint was more sensitive than freshwater, but an acute-to-chronic ratio was not available for saltwater fish and so some uncertainty exists over whether the chronic fish toxicity estimate is accurate, especially for saltwater species. An analysis of risk to birds and mammals by number of granules consumed could not be completed in this assessment because granule size for products was unknown. Some uncertainty exists for potential effects to terrestrial plants. The highest application rate tested with terrestrial plants was less than the maximum label rate so toxicity could not be precluded from the non-residential buildings, ornamentals, and roses uses although the lower rate did not result in adverse effects. However, incidents involving phytotoxicity primarily in residential settings have been associated with acephate and methamidophos although some of the products specified in the incident reports have subsequently been cancelled. The systemic nature of acephate adds to the uncertainty; it is taken up by plant roots and incorporated into plant tissues. This uncertainty applies both to plants and animals consuming them, including pollen.

Based on RQ values generated in this screening-level assessment, acephate and its degradate, methamidophos, can adversely impact animals and possibly plants that are exposed. Some uses, such as ornamentals, have relatively high application rates and may affect multiple taxa depending on the proximity of those species to application sites.

REFERENCES

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Fry, Meredith, Karen Milians, Dirk Young, and He Zhong, 2104. *Surface Water Concentration Calculator.* U. S. Environmental Protection Agency, Washington, DC.

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USEPA. 2007. Maximum Number of Crop Cycles Per Year in California for Methomyl Use Sites. Memo from Monisha Kaul (BEAD) to Melissa Panger (EFED). Dated 27 February 2007USEPA, 2009. Mason, Tiffany and Michael Davy, January 5, 2009, "Registration Review – Preliminary problem formulation for the Ecological Risk Assessment of Acephate," U.S. Environmental Protection Agency, Office of Pesticide Programs, DP Barcodes: 35704 and 354619, internal memorandeum to the Special Review and Reregistation Division.

USEPA, 2009. Mason, Tiffany, Michael Davy and William P. Eckel. "Registration Review – Preliminary problem formulation for the Ecological Risk Assessment of Acephate," Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protectin Agency, DP Barcodes: 35704, 354619, January 5, 2009.

USEPA. 2011a. Gelmann, Elyssa and R. David Jones, December 19, 2011, "Risks of Acephate Use to the Federally Threatened Bay Checkerspot Butterfly (*Euphydryas editha bayensis*), Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*), and California Tiger Salamander (*Ambystoma californiense*), Central California Distinct Population Segment And the Federally Endangered California Clapper Rail (*Rallus longirostris obsoletus*), California Freshwater Shrimp (*Syncaris pacifica*), California Tiger Salamander (*Ambystoma californiense*) Sonoma County Distinct Population Segment and Santa Barbara County Distinct Population Segment, Salt Marsh Harvest

Mouse (*Reithrodontomys raviventris*), San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*), and San Joaquin Kit Fox (*Vulpes macrotis mutica*)," U.S. Environmental Protection Agency, Office of Pesticide Programs, http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/2011/acephate2/analysis.pdf.

USEPA. 2011b. County-Level Usage for Acephate; Acrolein; Bromadiolone; Cholecalciferol; Difethaialone; Methyal Bromide; Methoprene; S-Methprene; Warfarin; and Warfarin, Sodium Salt in California in Suppport of a San Francisco Bay Endangered Species Assessment. Memo from Biological and Economic Analysis Division, Office of Pesticide Programs, U.S. Environmental Protection Agency. July 2011.

USEPA. 2014. "Guidance for Assessing Pesticide Risks to Bees," from Don Brady, Director to Environmental Fate and Effects Division, June 19, 2014: http://www2.epa.gov/sites/production/files/2014-06/documents/pollinator_risk_assessment_guidance_06_19_14.pdf.

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APPENDIX A. Input Files for Aquatic Assessment for Acephate Modeled as the Methamidophos Degradate Using SWCC

File name	Date	Location/Use
Weather Data Files (dvf)		
W03813	July 3, 2002	Macon, GA
W03940	July 3, 2002	Jackson, MS
W12834	July 3, 2002	Daytona Beach, FL
W12842	July 3, 2002	Tampa, FL
W12844	July 3, 2002	West Palm Beach, FL
W13722	July 3, 2002	Raleigh, NC
W14826	July 3, 2002	Flint, Michigan
W14860	July 3, 2002	Erie, Pennsylvania
W14914	July 3, 2002	Fargo, North Dakota
W23234	July 3, 2002	San Francisco, CA
W23273	July 3, 2002	Santa Maria, CA
W24232	July 3, 2002	Salem, OR
W93805	July 3, 2002	Tallahassee, FL
Scenario and Watershed Files ('.scn')		
CAlettuceSTD	Feb 10, 2014	Irrigated California lettuce
CAImperviousRLF	Feb 10, 2014	Impervious surface, used with12834 weather; paved areas
CARowCropRLF_V2	Feb 10, 2014	California truck crops and beans
FLcabbageSTD	Feb 10, 2014	Cabbage in Florida, used for fallow & cauliflower
FLcitrusSTD	Feb 10, 2014	Citrus in Florida
FLnurserySTD_V2	Feb 10, 2014	FL nurseries; used for ornamentals, roses, shrubs & vines,
FLpeppersSTD	Feb 10, 2014	Peppers in FL
FLtomatoSTD_V2.txt	Feb 10, 2014	Florida tomatoes
FLTurfSTD	Feb 10, 2014	Sod farms in Florida; used for Bermuda grass & fire ants, recreational lawns, rights-of-way, sod farm
GAPeachesSTD	Feb 10, 2014	Deciduous fruit trees in GA
GAPecanSTD	Feb 10, 2014	pecans in GA, used for nut orchards; pine seed orchards; Christmas trees
MIBeansSTD	Feb 10, 2014	Common beans in Michigan
MNalfalfaOP	Feb 10, 2014	Alfalfa in Minnesota
MSCottonSTD	Feb 10, 2014	Cotton in Mississippi
NCtabaccoSTD	Feb 10, 2014	Tobacco in North Carolina
NYGrapesSTD	Feb 10, 2014	grapes in New York
ORMintSTD.txt	Feb 10, 2014	Oregon mint standard scenario
Input files for Individual Simulations ('.SWI')		
Methamidophos_CAcelery	July 2, 2014	Acephate as methamidophos on celery in CA
Methamidophos_CAlettuce	January 13, 2016	Acephate as methamidophos on lettuce in CA
Methamidophos_FLBermudagrass	January 13, 2016	Acephate as methamidophos on Bermuda Grass turf in FL
Methamidophos_FLcauliflower	July 2, 2014	Acephate as methamidophos on cauliflower in FL
Methamidophos_FLcitrus1	July 2, 2014	Acephate as methamidophos on citrus in FL, application pattern 1
Methamidophos_FLcitrus2	July 3, 2014	Acephate as methamidophos on citrus in FL, application pattern 2
Methamidophos_FLgolf	April 4, 2017	Acephate as methamidophos on golf courses in FL
Methamidophos_FLfireants	July 2, 2014	Acephate as methamidophos on fire ants in FL
methamidophos_FLnonresbuildingperim	April 4, 2017	Acephate as methomidophos around building perimeters, max application practice
methamidophos_FLnonresbuildingperim 2	February 22, 2017	Acephate as methomidophos around building perimeters, max application practice 0.073 lb/ga
methamidophos_FLnonresbuildingperim 3	February 16, 2017	Acephate as methomidophos around building perimeters, 0.073 lb/gal 4 apps monthly
methamidophos_FLnonresbuildingperim 4	February 22, 2017	Acephate as methomidophos around building perimeters, 0.073 lb/gal 1 app
methamidophos_FLnonresbuildingperim 5	April 4, 2017	Acephate as methomidophos around building perimeters, 0.073 lb/gal 1 app, 1 building
Methamidophos_FLornamentals	March 6, 2017	Acephate as methamidophos on ornamentals in FL

File name	Date	Location/Use
Methamidophos_FLornamentals 2	March 6, 2017	Acephate as methamidophos on ornamentals in FL , 1 lb rate
Methamidophos_FLornamentals 3	March 6, 2017	Acephate as methamidophos on ornamentals in FL, 4 apps
Methamidophos_FLornamentals 4	March 6, 2017	Acephate as methamidophos on ornamentals in FL, 1 app
Methamidophos_FLpeppers_bell	January 13, 2016	Acephate as methamidophos on bell peppers in FL
Methamidophos_FLpeppers_nonbell	January 13, 2016	Acephate as methamidophos on non-peppers in FL
Methamidophos_FLrightsofway	July 2, 2014	Acephate as methamidophos on rights of way in FL
Methamidophos_FLroses	January 14, 2016	Acephate as methamidophos on roses in FL
Methamidophos_FLsodfarm	July 2, 2014	Acephate as methamidophos on sod farms in FL
Methamidophos_FLsodfarm	January 14, 2016	Acephate as methamidophos on wasteland in FL
Methamidophos_GAFruitTree	January 14, 2016	Acephate as methamidophos on fruit trees in GA
Methamidophos_GANuts	January 13, 2016	Acephate as methamidophos on nut trees in GA
Methamidophos_GApineseedorchard	January 13, 2016	Acephate as methamidophos on pine seed orchards in GA
Methamidophos_GAXmastree	July 2, 2014	Acephate as methamidophos on Christmas trees in GA
Methamidophos_MIBeans	July 2, 2014	Acephate as methamidophos on dry beans in MI
Methamidophos_MNAlfalfa	January 13, 2016	Acephate as methamidophos on alfalfa in MN
Methamidophos_MScotton	January 13, 2016	Acephate as methamidophos on cotton,
Methamidophos_NCpeanut	January 13, 2016	Acephate as methamidophos on peanuts in NC
Methamidophos_NCtobacco	January 13, 2016	Acephate as methamidophos on tobacco in NC
Methamidophos_NYGrape1	July 3, 2014	Acephate as methamidophos on grapes, pattern1 in NY
Methamidophos_NYGrape2	July 3, 2014	Acephate as methamidophos on grapes, pattern 2 in NY
Methamidophos_ORmint	July 2, 2014	Acephate as methamidophos on mint in NY

APPENDIX B. MRID Bibliography for Environmental Fate Studies

Submitted Environmental Fate and Product Chemistry Studies

103301 Acephate Fate/Chemistry Bibliography MRID-SAN Doc # match - Revised 03/01/11

161-1 Hydrolysis

MRID	Citation Reference
14494	Tucker, B.V. (1972) Identification of Orthene Hydrolysis Products. (Unpublished study received Aug 7, 1972 under 239-2406; submit- ted by Chevron Chemical Co., Richmond, Calif.; CDL:001571-E)
14986	Crossley, J. (1972) Hydrolysis of Orthene. (Unpublished study re- ceived Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-T)
14987	Lee, H. (1972) Photodegradation of Orthene in Water. (Unpublished study received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-U)
14988	Tucker, B.V. (1972) Orthene Stability in Soil Leachate. (Unpub- lished study received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-V)
15202	Tucker, B.V. (1972) Stability of Orthene to Sunlight. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chev- ron Chemical Co., Richmond, Calif.; CDL:223490-E)
15216 see 14494	Tucker, B.V. (1972) Identification of Orthene Hydrolysis Products. (Unpublished study received Mar 27, 1973 under 239-EX-60; sub- mitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-AC)
41081604	Gaddamidi, V.; Verrips, I. (1988) Hydrolysis of ?Carbon 14|-Aceph- ate. Unpublished study prepared by Chevron Chemical Co. 49 p.
46173201	Gohre, K. (2003) Hydrolysis of (S-methyl-(Carbon 14)) Acephate at pH 9. Project Number: VP/26497, V/03/26497. Unpublished study prepared by Valent Dublin Laboratory. 89 p.

161-2 Photodegradation-water

MRID	Citation Reference
41081603	Gaddamidi, V. (1988) Photolysis Studies of ?Carbon 14|-Acephate in Water. Unpublished study prepared by Chevron Chemical Co. 45 p.
45526202	Tierney, D.; Christensen, B.; Culpepper, V. (2001) Chlorine Degradation of Six Organophosphorus Insecticides and Four Oxons in a Drinking Water Matrix: Final Report: Lab Project Number: 1562-00: 00102. Unpublished study prepared by En-Fate, LLC. 186 p.
14987	Lee, H. (1972) Photodegradation of Orthene in Water. (Unpublished study received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-U)

161-3 Photodegradation-soil

MRID	Citation Reference
15202	Tucker, B.V. (1972) Stability of Orthene to Sunlight. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chev- ron Chemical Co., Richmond, Calif.; CDL:223490-E)
40504810	Chen, Y. (1987) Acephate Photodegradation on Soil: Proj. ID MEF- 0050. Unpublished study prepared by Chevron Chemical Co., Ortho Research Center. 29 p.

162-1 Aerobic soil metabolism

MRID	Citation Reference
14991	Tucker, B.V. (1972) Orthene Soil Metabolism--Laboratory Studies. (Unpublished study including supplement, received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-Z)
15211	Tucker, B.V. (1972) Comparison of Orthene Soil Metabolism under Aerobic and Anaerobic Conditions. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-U)

162-2 Anaerobic soil metabolism

MRID	Citation Reference
41137901	Panthani, A. (1989) Anaerobic Soil Metabolism Study of Acephate: Project ID MEF-0107. Unpublished study prepared by Chevron Chemical Co. 60 p.
15211	Tucker, B.V. (1972) Comparison of Orthene Soil Metabolism under Aerobic and **Anaerobic** Conditions. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-U)

162-3 Anaerobic aquatic metab.

MRID	Citation Reference
43971601	Esser, T. (1996) Anaerobic Aquatic Metabolism of (S-(carbon 14)H3)-Acephate: Lab Project Number: 515W: V10988A: 5-128-2125. Unpublished study prepared by PTRL West, Inc. 178 p.

163-1 Leach/adsorp/desorption

MRID	Citation Reference

14992 Tucker, B.V. (1972) Orthene Leaching in Soil. (Unpublished study including supplementary report, received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-AA)

14988 Tucker, B.V. (1972) Orthene Stability in Soil Leachate. (Unpub- lished study received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:091774-V)

15205 Tucker, B.V. (1972) **The Rat Toxicity, Soil and Plant Stabilities of Some Possible Orthene Metabolites.** (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-I)

15209 Tucker, B.V. (1972) Comparison of Acephate Soil Leaching and Sta- bility in Wet and Dry Soil. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Rich- mond, Calif.; CDL:223490-S)

15212 Warnock, R.E. (1972) Orthene Leaching Study--EPA Protocol. (Unpub- lished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-X)

15213 Tucker, B.V. (1972) Leachability of Orthene Residues in Soil 150 Days after Orthene Treatment--Greenhouse Test. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chev- ron Chemical Co., Richmond, Calif.; CDL:223490-Y)

40928 Warnock, R.E. (1974) **Mobility of Benthiocarb** and pCl-Benzoic acid in Soil As Determined by Soil TLC Techniques. (Unpublished study received Mar 18, 1976 under 239-2449; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:095091-I)

64796 Pack, D.E. (1980) **Mobility of Naled and Dichlorvos in Soil** As De- termined by Soil Thin-layer Chromatography: File No. 722.2. (Unpublished study received Oct 20, 1980 under 239-1633; submit- ted by Chevron Chemical Co., Richmond, Calif.; CDL:243547-A)

96972 Pack, D.E. (1977) **Soil Mobility of Captan, Folpet and Captafol** As Determined by Soil Thin-layer Chromatography: File No. 722.0. (Unpublished study received May 30, 1978 under 239-2211; sub- mitted by Chevron Chemical Co., Richmond, Calif.; CDL:234046-N)

40322701 Pack, D. (1987) Estimation of Soil Adsorption Coefficient of Ace- phate from TLC Data: Lab Project ID: MEF-0052/8711319. Unpub- lished study prepared by Chevron Chemical Co. 38 p.

40504811 Pack, D.; Verrips, I. (1988) Freundlich Soil Adsorption/Desorption Coefficients of Acephate and Soil Metabolites: Proj. ID 8800031. Unpublished study prepared by Chevron Chemical Co. 31 p.

164-1 Terrestrial field dissipation

MRID	Citation Reference
99760	Roberts, R.; Pieper, G. (1976) **Residue Analysis** of Sevin-4-oil **(Carbaryl), Orthene, and Dimilin** in Cooperative Safety Tests on Non-target Organisms. (U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station; unpublished study; CDL: 096171-E)
40504812	Lai, J. (1987) Terrestrial Field Dissipation of Acephate (Missis- sippi Tobacco Field): Proj ID T7015FD. Unpublished study pre- pared by Chevron Chemical Co. 155 p.
40504813	Lai, J. (1987) Terrestrial Field Dissipation of Acephate (Iowa Soy- bean Field): Proj. ID T7016FD. Unpublished study prepared by Chevron Chemical Co. 189 p.

40504814	Lai, J. (1987) Terrestrial Field Dissipation of Acephate (Califor- nia Bell Pepper Field): Proj. ID T7014FD. Unpublished study prepared by Chevron Chemical Co. 148 p.
40504815	Lai, J. (1987) Terrestrial Field Dissipation of Acephate (Florida Cauliflower Field): Proj. ID T7013FD. Unpublished study pre- pared by Chevron Chemical Co. 157 p.
41327601	Lai, J. (1989) Storage Stability of Acephate in Frozen Soil: Lab Project Number: R12SOILLSS. Unpublished study prepared by Chevron Chemical Co. 58 p.
41327602	Lai, J. (1989) Addendum to Terrestrial Field Dissipation of Acepha- te (Florida Cauliflower Field): Lab Project Number: R12t7013FD. Unpublished study prepared by Chevron Chemical Co. 18 p.
41327603	Lai, J. (1989) Addendum to Terrestrial Field Dissipation of Acephate (California Bell Pepper Field): Lab Project Number: R/12T7014FDA. Unpublished study prepared by Chevron Chemical Co. 37 p.
41327604	Lai, J. (1987) Addendum to Terrestrial Field Dissipation of Acephate (Iowa Soybean Field): Lab Project Number: R12T7016FDA. Unpublished study prepared by Chevron Chemical Co. 23 p. Co. 23 p.
41327605	Lai, J. (1989) Addendum to Terrestrial Field Dissipation of Acephate (Mississippi Tobacco Field): Lab Project Number: R12T7015FDA. Unpublished study prepared by Chevron Chemical Co. 35 p.

164-2 Aquatic field dissipation

MRID	Citation Reference
15221	
93943	Lyons, D.B.; Buckner, C.H.; McLeod, B.B.; et al. (1976) The Effects of **Fenitrothion, Matacil^(R)l and Orthene^(R)l on Frog Larvae**: Report CC-X-129. (Canada, Forestry Service, Chemical Control Research Institute; unpublished study; CDL:246666-B)
99760	Roberts, R.; Pieper, G. (1976) **Residue Analysis** of Sevin-4-oil (Carbaryl), Orthene, and Dimilin in Cooperative Safety Tests on Non-target Organisms. (U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station; unpublished study; CDL: 096171-E)
129973	Wilson, D.; Wan, M. (1977) Effects of Orthene and Dimilin Insecti- cides on Selected Non-target Arthropods in a Douglas-fir Forest Environment: Report No. EPS-5-PR-76-4; NTP-80. (Unpublished study received Feb 7, 1977 under unknown admin. no.; prepared by **U.S. Environmental Protection Service, Pollution Abatement Branch, Pacific Region**, submitted by Thompson-Hayward Chemical Co., Kansas City, KS; CDL:250899-S)
5015248	Sanborn, J.R. 1974. Fate of Select Pesticides in the Aquatic Environment. EPA 660/3-74-025
5018064	Szeto, S.Y. 1979. The Fate of Acephate and Carbaryl in water. J. of Env. Science and Health

164-3 Forest field dissipation

MRID	Citation Reference

14635 O'Connor, T.F.; Galletta, T.A. (1975) Environmental Impact Study of Aerially Applied Orthene on a Forest and Aquatic Ecosystem: LOTEL Report 174. (Unpublished study received Jun 30, 1975 un- der 239-2443; prepared by State Univ. of New York--Oswego, Lake Ontario Environmental Laboratory, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:225768-A)

95419 Wilson, D.M.; Wan, M.T.K. (1977) Effects of Orthene and Dimilin Insecticides on Selected Non-target Arthropods in a Douglas-fir Forest Environment: Report No. EPS-5-PR-76-4. (U.S. Environ- mental Protection Service, Pacific Region, Pollution Abatement Branch; unpublished study; CDL:234512-V)

158536 Kingsbury, P. (1984) **Environmental impact assessment** of insecti- cides used in Canadian forests. P. 365-376 in Chemical and Bio- logical Controls in Forestry, ACS Symposium Series No. 238, edited by W. Garner and J. Harvey. American Chemical Society.

5015409 Szeto, S.Y. Residues in Douglas Fir needles and forest litter following an aerial application of Acephate

165-0 Accumulation Studies -- General

MRID	Citation Reference
14635	O'Connor, T.F.; Galletta, T.A. (1975) Environmental Impact Study of Aerially Applied Orthene on a Forest and Aquatic Ecosystem: LOTEL Report 174. (Unpublished study received Jun 30, 1975 un- der 239-2443; prepared by State Univ. of New York--Oswego, Lake Ontario Environmental Laboratory, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:225768-A)
15244	Booth, G.M.; Yu, C.C. (1972?) Progress Report on the Fate of~O~?, ?~S~?-dimethyl acetylphosphoramidothioate (Orthene) in a Model Ecosystem. (Unpublished study received Mar 27, 1973 under 239- EX-60; prepared by Brigham Young Univ., Dept. of Zoology in cooperation with Illinois Natural History Survey, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-AD)
66341	U.S. Environmental Protection Agency, Environmental Research Labo- ratory (1981) Acephate, Aldicarb, Carbophenothion, DEF, EPN, Ethoprop, Methyl Parathion, and Phorate: Their Acute and Chronic Toxicity, Bioconcentration Potential, and Persistence as Related to Marine Environments: **EPA-600/4-81-023**. (Unpublished study)
14496	Tucker, B.V. (1972) Residues of Orthene and Ortho 9006 in a Marine Diatom Growing in Treated Water. (Unpublished study received Aug 7, 1972 under 239-2406; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:001571-U)
14497	Tucker, B.V. (1972) Residues in Earthworms in Orthene and Ortho 9006 Treated Soil. (Unpublished study received Aug 7, 1972 un- der 239-2406; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:001571-V)
14638	Devine, J.M. (1975) Environmental Impact Study of Aerially Applied Orthene on a Forest and Aquatic Ecosystem: Persistence of Or- thene Residues in the Forest and Aquatic Environment: LOTEL Re- port 174. (Unpublished study received Jun 30, 1975 under 239- 2443; prepared by State Univ. of New York--Oswego, Lake Ontario Environmental Laboratory, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:225768-D)
15242	Tucker, B.V. (1973) Orthene and Ortho 9006 in~Daphnia magna~Living in Treated Water. (Unpublished study received Mar 27, 1973 un- der 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-AA)

15243 Sleight, B.H., III. (1972) Research Report: Exposure of Fish to 14C-Labeled Orthene: Accumulation, Distribution and Elimination of Residues. (Unpublished study received Mar 27, 1973 under 239-EX-60; prepared by Bionomics, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-AC)

165-1 Confined rotational crop

MRID	Citation Reference
40504816	Rose, A. (1988) Acephate Confined Accumulation on Rotational Crops: Lettuce and Wheat: Laboratory Project ID MEF-0019. Unpublished study prepared by Chevron Chemical Company. 9 p.
40874101	Panthani, A. (1988) Acephate Confined Accumulation Studies on Rota- tional Crops: Lettuce and Wheat: Project ID: MEF-01019. Unpu- blished study prepared by Chevron Chemical Co. 48 p.
15210	Warnock, R.E. (1973) 14C-Orthene Residues in Soil and Uptake by Carrots--EPA Protocol. (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-T)

166-1 Ground water-small prospective

MRID	Citation Reference
45526201	Tierney, D.; Christensen, B.; Culpepper, V. (2001) Drinking Water Monitoring Study for Six Organophosphate Insecticides and Four Oxons from 44 Community Water Systems on Surface Water in the United States: Final Report: Lab Project Number: 1330-00: 00100. Unpublished study prepared by Syngenta Crop Protection, En-Fate, LLC, and EASI Laboratory. 880 p.

166-2 Ground water-small retrospective

MRID	Citation Reference
45013001	Christensen, B. (1999) Monitoring Site Selection and Participating Community Water Supplies Report for: Community Water System Surface Drinking Water Monitoring Study for Organophosphate Pesticides and their Major Degradation Products in the United States: Lab Project Number: 006: 00100. Unpublished study prepared by En-fate, LLC, and URS Greiner Woodward Clyde. 316

201-1 Droplet size spectrum

MRID	Citation Reference
40323301	Akesson, N. (1986) Droplet Size Spectrum Study: Orthene: Lab. Proj. ID. 8702437-A. Unpublished study prepared by Univ. of Califor- nia, Davis. 33 p.
41023503	Akesson, N. (1989) Droplet Size Spectrum Study: Orthene: Project ID: 8702437-A. Unpublished study prepared by University of California. 6 p.

43757802 Johnson, D. (1995) Atomization Droplet Size Spectra for Spray Drift Test Substances: 1993 Field Trial Conditions: Lab Project Number: A93-008. Unpublished study prepared by Stewart Agricultural Research Services, Inc. 216 p.

202-1 Drift field evaluation

MRID	Citation Reference
40323302	Akesson, N. (1986) Drift Field Evaluation: Orthene: Lab. Proj. ID: 8702437-B. Unpublished study prepared by Univ. of California, Davis. 8 p.
41023504	Akesson, N. (1989) Drift Field Evaluation: Orthene: Project ID: 8702437-A. Unpublished study prepared by University of Califor- nia. 11 p.
43535802	Johnson, D. (1995) Spray Drift Task Force: 1993 Hot, Humid Aerial Field Study in Texas: Lab Project Number: F93-017. Unpublished study prepared by Stewart Agricultural Research Services, Inc. 724 p.
43803501	Johnson, D. (1995) Drift from Applications with Aerial Sprayers: Integration and Summary of 1992 and 1993 Field Studies: Lab Project Number: I94-002: F92-008: F93-015. Unpublished study prepared by Stewart Agricultural Research Services, Inc. 200 p.
44070001	Johnson, D. (1996) Frozen Storage Stability of Malathion, Diazinon, Carbaryl, and/or Acephate Residues in/on Alpha-Cellulose, Polyurethane Foam, Polyester String, Water, and Tank Mixes: Lab Project Number: F93-014: ML93-0364-SDP. Unpublished study prepared by Morse Laboratories, Inc. 174 p.
44178701	Johnson, D. (1996) Spray Drift Task Force Field Testing Protocol and Techniques: Lab Project Number: T95-004. Unpublished study prepared by Spray Drift Task Force. 175 p.

Volatility

29681 Elliott, E.J.; Leary, J.B. (1977) Orthene--Volatility Relative to Diazannon, Dursban and Malathion. (Unpublished study received Sep 14, 1978 under 239-EX-89; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:235099-B)

Non Guideline Selections

14890 Bledsoe, M.E. (1977) ?Field Evaluations of Orthene Residual Insec- ticide|. (Unpublished study received Jan 29, 1979 under 239- 2462; prepared in cooperation with National Pest Control Associ- ation, submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 236860-D)

14997 Leary, J.B. (1971) Addendum to RM-12A--Extraction Procedure for Soil. (Unpublished study received Feb 23, 1972 under 2G1248; submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 091774-AF)

14730 Leary, J.B. (1972) Orthene--Efficiency of Extraction of Residues of Orthene and Ortho 9006 in Soil. (Unpublished study received Mar 27, 1973 under 3F1375; submitted by Chevron Chemical Co., Rich- mond, Calif.; CDL:093665-G)

15201 Crossley, J. (1972) Volatility of Orthene on a Leaf Surface. (Un- published study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223490-D)

15223 Warnock, R.E. (1973) Orthene Metabolism in Japanese Quail (Co- turnix). (Unpublished study received Mar 27, 1973 under 239-EX-60; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-E)

15241 Tucker, B.V. (1972) Potential Exposure of Field Workers to Orthene. (Unpublished study received Mar 27, 1973 under 239-EX-60; sub- mitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-Y)

15281 Wooldridge, A.W.; Willcox, H.; McIntyre, T. (1973) Orthene 1.0S, Orthene 1.5S, & Orthene 2.0S. (Unpublished study received Jun 30, 1975 under 239-2443; prepared in cooperation with State Univ. of New York--Oswego, Lake Ontario Environmental Laboratory and U.S. Dept. of Agriculture, Animal and Plant Health Inspec- tion Service, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:222345-B)

29738 Pieper, G.R.; Roberts, R.B.; Larson, J.E. (1977) Residue Analysis of Carbaryl, Diflubenzuron and Acephate in Foliage, Duff, Water, Soil, Sediment and Bee Pollen. Final rept. (Unpublished study received Jul 31, 1978 under 148-1259; prepared in cooperation with Pacific Southwest Forest and Range Experiment Station, sub- mitted by Thompson-Hayward Chemical Co., Kansas City, Kans.; CDL:234514-D)

5018849 Rosenberg, A. 1979. Microbial cleavage of various organophosphorous insecticides. Microbiology 37(5)

5017981 Booth,G.M. 1975. Usefulness of Model Ecosystems in Isecticide Development.

15244 Booth, G.M.; Yu, C.C. (1972?) Progress Report on the Fate of~O~?, ?~S~?-dimethyl acetylphosphoramidothioate (Orthene) in a Model Ecosystem. (Unpublished study received Mar 27, 1973 under 239- EX-60; prepared by Brigham Young Univ., Dept. of Zoology in cooperation with Illinois Natural History Survey, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-AD)

26981 Metcalf, R.L.; Sanborn, J.R. (1975) Illinois Natural History Survey Bulletin: Pesticides and Environmental Quality in Illinois: Vol- ume 31, Article 9. Urbana, Ill.: State of Illinois, Dept. of Registration and Education, Natural History Survey Div. (Also ?~In~unpublished submission received Jul 19, 1978 under 201-403; submitted by Shell Chemical Co., Washington, D.C.; CDL: 234470-AB)

5007862 Bull, D. 1978. Fate and Efficacy of Acephate after application to plants and insects.

5020468 Knaak, J.B. Safety effectiveness of closed transfer mixing loading in preventing exposure

APPENDIX C. MRID Bibliography for Environmental Toxicity Studies

Submitted Ecotoxicity Studies

103301 Acephate Eco Effects Bibliography SAN drive Match - Revised 03/01/11

71-1 Avian Single Dose Oral Toxicity

MRID	Citation Reference
14700	Mastalski, K.; Jenkins, D.H. (1970) Report to Chevron Chemical Company, Ortho Division: Acute Oral Toxicity Study with RE 12,420 Technical in Mallard Ducks: IBT No. J9110. (Unpublished study received Jun 21, 1972 under 239-EX-61; prepared by Indus- trial Bio-Test Laboratories, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AE)
14701	Mastalski, K.; Jenkins, D.H. (1970) Report to Chevron Chemical Company, Ortho Division: Acute Oral Toxicity Study with RE 12,420 Technical in Ringneck Pheasants: IBT No. J9110. (Unpub- lished study received Jun 21, 1972 under 239-EX-61; prepared by Industrial Bio-Test Laboratories, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AF)
15962	Hudson, R.H. (1972) Orthene Data: Acute Oral: Mallards. (Internal Report Series in Pharmacology; unpublished study received Mar 27, 1973 under 3F1375; prepared by U.S. Fish and Wildlife Ser- vice, **Denver Wildlife Research Center**, Section of Pesticide- Wildlife Ecology, Unit of Physiological and Pharmacological Studies, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:093671-F)
93914	Zinkl, J.G.; Roberts, R.B.; Shea, P.J.; et al. (1981) Toxicity of acephate and methamidophos to dark-eyed junkos. **Archives of Environmental Contamination and Toxicology 10:185-192. (A**lso ?~In~unpublished submission received Jan 26, 1982 under 239- 2471; submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 246657-L)
43939301	Campbell, S.; Jaber, M.; Beavers, J. (1992) ORTHENE 15 Granular and ORTHENE 15 Granular Inert Premix: An Acute Oral Toxicity Study in the Northern Bobwhite: Lab Project Number: 263-127. Unpublished study prepared by Wildlife Int'l. Ltd. 22 p.
14703	Rausina, G. (1972) Report to Chevron Chemical Company, Ortho Di- vision: 21-Day Perching Bird Dermal Toxicity Study with Orthene 75S in English Sparrows: IBT No. A776. (Unpublished study re- ceived Jun 21, 1972 under 239-EX-61; prepared by Industrial Bio-Test Laboratories, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AH)
14704	Fletcher, D. (1972) Report to Chevron Chemical Company, Ortho Divi- sion: Acute Dermal Toxicity Study with Orthene 75S, SX-358 in Bobwhite Quail: IBT No. J1562. (Unpublished study received Jun 21, 1972 under 239-EX-61; prepared by **Industrial Bio-Test Laboratories**, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AI)
48924601	Dias, N.A. 2012. Acephate: Acute Oral Toxicity (LD_{50}) to the Zebra Finch. Unpublished study performed by Huntingdon Life Sciences, Ltd., Huntingdon, Cambridgeshire, England. Laboratory Study No. ADB0074. Study sponsored by Consumer Specialty Products Association Inc. for the Acephate Task Force Steering Committee/Joint Venture, Washington D.C. Study initiated March 14, 2012 and completed August 17, 2012.
48924602	Ross, V.A. 2012. Methamidophos: Acute Oral Toxicity (LD_{50}) to the Zebra Finch. Unpublished study performed by Huntingdon Life Sciences, Ltd., Huntingdon, Cambridgeshire, England. Laboratory Study No. ADB0082. Study sponsored by Consumer Specialty Products

Association Inc. for the Acephate Task Force Steering Committee/Joint Venture, Washington D.C. Study initiated February 28, 2012 and completed August 24, 2012.

71-2 Avian Dietary Toxicity

MRID	Citation Reference
15956	Fletcher, D. (1976) Report to Chevron Chemical Company: 8-Day Dietary LCI50^ Study with Orthene Technical in Bobwhite Quail: IBT No. 8580-09326. (Unpublished study received Mar 23, 1977 under 239-2443; prepared by **Industrial Bio-Test Laboratories, Inc**., submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 228753-A)
15957	Fletcher, D. (1976) Report to Chevron Chemical Company: 8-Day Dietary LCI50^ Study with Orthene Technical in Mallard Duck- lings: IBT No. 8580-09327. (Unpublished study received Mar 23, 1977 under 239-2443; prepared by **Industrial Bio-Test Labora- tories, Inc**., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:228753-B)
93914	Zinkl, J.G.; Roberts, R.B.; Shea, P.J.; et al. (1981) Toxicity of acephate and methamidophos to dark-eyed junkos. **Archives of Environmental Contamination and Toxicology 10:185-192.** (Also ?~In~unpublished submission received Jan 26, 1982 under 239- 2471; submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 246657-L)
105147	Fink, R.; Beavers, J.; Joiner, G.; et al. (1982) Final Report: **Preliminary Investigation--Bobwhite Quail: Effects of Feeding Corn Seed Treated with Orthene 80 Seed Protectant**: Project No. 162-146. (Unpublished study received Jun 17, 1982 under 239-EX-97; prepared by Wildlife International Ltd., submitted by Chevron Chemical Co., Richmond, CA; CDL:247731-A)

71-3 Wild mammal toxicity

MRID	Citation Reference

71-4 Avian Reproduction

MRID	Citation Reference
14511	Fletcher, D. (1972) **Status Summary to Chevron Chemical Company**, Ortho Division: Residue and Reproduction Study with Orthene, SX-357 in Bobwhite Quail: IBT No. J1378. (Unpublished study received Aug 7, 1972 under 239-2406; prepared by **Industrial Bio-Test Laboratories, Inc**., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:051142-H)
15231	Fletcher, D. (1972) Report to Chevron Chemical Company, Ortho Divi- sion: Toxicity, Reproduction and Residue Study with Orthene in Bobwhite Quail: IBT No. J1378. (Unpublished study received Mar 27, 1973 under 239-EX-60; prepared by Industrial Bio-Test Labo- ratories, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223489-M)
29691	Beavers, J.B.; Fink, R.; Grimes, J.; et al. (1979) Final Report: One-Generation Reproduction Study--Mallard Duck: Project No. 162-107. Includes method dated Aug 28, 1978. (Unpublished study including letters dated Dec 11, 1978 from J.B. Beavers to Francis X. Kamienski; Jan 12, 1979 from F.X. Kamienski to J.B. Leary; Jan 15, 1979 from J.B. Beavers

to Francis X. Kamienski; Mar 1, 1979 from J.B. Beavers to Francis X. Kamienski, received Feb 21, 1980 under 239-2418; prepared by Wildlife International, Ltd., submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 241824-C)

29692 Beavers, J.B.; Fink, R.; Grimes, J.; et al. (1979) Final Report: One-Generation Reproduction Study--Bobwhite Quail: Project No. 162-106. Includes method dated Aug 28, 1978. (Unpublished study including letters dated Dec 11, 1978 from J.B. Beavers to Francis X. Kamienski; Jan 12, 1979 from F.X. Kamienski to J.B. Leary; Jan 15, 1979 from J.B. Beavers to Francis X. Kamienski; Mar 1, 1979 from J.B. Beavers to Francis X. Kamienski; Apr 2, 1979 from J.B. Beavers to F.X. Kamienski, received Feb 21, 1980 under 239-2418; prepared by Wildlife International, Ltd., sub- mitted by Chevron Chemical Co., Richmond, Calif.; CDL:241824-D)

93907 Petersen, B.; Palmer, D.; Ryder, R. (1981) The Effects of Acephate on Rangeland Wildlife. (Unpublished study received Jan 26, 1982 under 239-2471; prepared by **Colorado State Univ., Fishery and Wildlife Biology Dept.**, submitted by Chevron Chemical Co., Richmond, Calif.; CDL:246657-C)

71-5 Simulated or Actual Field Testing

MRID	Citation Reference
93908	**U.S. Fish and Wildlife Service**, Fort Collins Field Station (1978) Field Test of Candidate Insecticide Orthene^(R)I Effects on Rangeland Birds. **1978 annual progress** rept., Oct 1, 1977-Sep 30, 1978. (Unpublished study; CDL:246657-D)
93909	McEwen, L.C.; DeWeese, L.R. (1981) Summary of 1981 Field Studies of Acephate Effects on Rangeland Wildlife. (U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center; unpublished study; CDL:246657-E)
93911	Zinkl, J.G. (1977?) Brain and Plasma Cholinesterase Activity of Dark-eyed Juncos (?~Junco hyemalis~?) Given Acephate Orally and Fed Acephate-dosed Spruce Budworm Larvae. (Unpublished study received Jan 26, 1982 under 239-2471; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:246657-H)
99764	Hendersen, C.; Jorgensen, C.; Smith, H. (1976) Small Mammal Re- sponses to Experimental Pesticide Applications in Coniferous Forests. **Annual rept.** (Unpublished study received Jun 22, 1977 under 6F1773; prepared by Brigham Young Univ., submitted by Thompson-Hayward Chemical Co., Kansas City, KS; CDL:096171-I)
141694	Rudolph, S.; Zinkl, J.; Anderson, D.; et al. (1984) Prey-capturing ability of American kestrels fed DDE and acephate or acephate alone. **Arch. Environ. Contam. Toxicol. 13:367-372.**
163173	Bart, J. (1979) Effects of Acephate and Sevin on forest birds. J. Wildl. Manage. 43(2):544-549.
93938	Buckner, C.H.; McLeod, B.B.; Lidstone, R.G. (1976) Environmental Impact Studies of Spruce Budworm (Choristoneura fumiferana Clemens) Control Programmes in New Brunswick in 1976: Information Report CC-X-135. (Canada, Forestry Service, Chemical Control Research Institute; unpublished study; CDL:246665-E)

72-1 Acute Toxicity to Freshwater Fish

MRID	Citation Reference

120401	Woodward, D.; Mauck, W. (1980) Toxicity of five forest insecticides to cutthroat trout and two species of aquatic invertebrates. **Bull. Environm. Contam. Toxicol. 25:846-854.** (Submitter 69597; also In unpublished submission received Dec 9, 1982 under 3125- 327; submitted by Mobay Chemical Corp., Kansas City, MO; CDL: 248989-O)
125909	Schoettger, R.; Mauck, W. (1976) Toxicity of Experimental Forest Insecticides to Fish and Aquatic Invertebrates: (Submitter) 63089. (Unpublished study received Jun 26, 1978 under 3125-EX- 150; prepared by **U.S. Fish & Wildlife Service, Fish-Pesticide Research Laboratory,** submitted by Mobay Chemical Corp., Kansas City, MO; CDL:234509-T)
139500	Nishiuchi, Y. (1974) Fish Toxicity of Agricultural Chemicals and Its Evaluation. **Abstracted from: Kongetsu No Noyaku 18(10):84- 87.** (Unpublished study received Dec 8, 1977 under 464-431; sub- mitted by Dow Chemical U.S.A., Midland, Mich.; CDL:232666-S)
00014705	Hutchinson, C. (1970) Bioassay Report: Acute Toxicity of RE-12420 to Three Species of Freshwater Fish. (Unpublished study re- ceived Jun 21, 1972 under 239-EX-61; prepared by Bionomics, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 223505-AJ)
00014710	Thompson, J.P.; Huntoon, R.B. (1971) Fish Toxicity: Goldfish (?~Carassius auratus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Rich- mond, Calif.; CDL:223505-AO)
00014708	Thompson, J.P. (1971) Fish Toxicity: Channel Catfish (?~Ictiobus~ ?~cyprinellus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AM)
00014706	Thompson, J.P. (1971) Fish Toxicity: Bluegill (?~Lepomis macro?~- ?~chirus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AK)
00014707	Thompson, J.P. (1971) Fish Toxicity: Large Mouth Black Bass (?~Micropterus salmoides?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AL)
00014709	Thompson, J.P.; Huntoon, R.B. (1971) Fish Toxicity: Mosquito Fish (?~Gambusia affinis?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Rich- mond, Calif.; CDL:223505-AN)
5017149	Klaverkamp, J.F. 1975. Acute lethality and in vitro brain cholinesterase inhibition of acephate and fenitrothion in rainbow trout. Western Pharm. Society Conference.
5020323	Duangsawasdi, M. 1979. Acephate and fenitrothion toxicity in rainbow trout: effects of temperature stress and investigations on sites of action. Aquatic Toxicology.
40094602	Johnson, W.; Finley, M. (1980) Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates: Resource Publi- cation 137. US Fish and Wildlife Service, Washington, D.C. 106 p.

72-2 Acute Toxicity to Freshwater Invertebrates

MRID	Citation Reference
120401 Also 00014861 ?	Woodward, D.; Mauck, W. (1980) Toxicity of five forest insecticides to cutthroat trout and two species of aquatic invertebrates. **Bull. Environm. Contam. Toxicol. 25:846-854.** (Submitter 69597; also In unpublished submission received Dec 9, 1982 under 3125- 327; submitted by Mobay Chemical Corp., Kansas City, MO; CDL: 248989-O)

14565	Wheeler, R.E. (1978) 48 Hour Acute Static Toxicity of Orthene (SX911) to 1st Stage Nymph Water Fleas (~?Daphnia magna~Straus). (Unpublished study received Sep 13, 1978 under 239-2418; sub- mitted by Chevron Chemical Co., Richmond, Calif.; CDL:235203-A)
14712	Sleight, B.H., III (1971) Bioassay Report: Acute Toxicity of Or- thene 75S (CC2152 from SX 357, SX360) to Crayfish (?~Procambo?~- ?~rus clarki?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; prepared by Bionomics, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AQ)
47116601	Thompson, J. (1978) Daphnia 48-hour Static LC50: Orthene: Static Jar Test. Unpublished study prepared by U.S. Environmental Protection Agency, Animal Biology Lab. 4 p.

72-3 Acute Toxicity to Estuarine/Marine Organisms

MRID	Citation Reference
66341	U.S. Environmental Protection Agency, Environmental Research Labo- ratory (1981) Acephate, Aldicarb, Carbophenothion, DEF, EPN, Ethoprop, Methyl Parathion, and Phorate: Their Acute and Chronic Toxicity, Bioconcentration Potential, and Persistence as Related to Marine Environments: **EPA-600/4-81-023**. (Unpublished study)
14711	Sleight, B.H., III (19??) Bioassay Report: Acute Toxicity of Or- thene^(R)I (SX-257) to the Brown Shrimp (?~Penaeus aztecus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; pre- pared by Bionomics, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AP)
14713	Sleight, B.H., III (1970) Bioassay Report: Acute Toxicity of RE- 12420 to Atlantic Oyster Embryo (?~Crassostrea virginica?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; pre- pared by Bionomics, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AR)

72-4 Fish Early Life Stage/Aquatic Invertebrate Life Cycle Study

MRID	Citation Reference
14547	Rabeni, C.F. (1978) The impact of Orthene, a Spruce Budworm In- secticide, on Stream Fishes. (Unpublished study received Nov 24, 1978 under 239-2418; prepared by Univ. of Maine, Cooperative Fishery Research Unit in cooperation with Entomology Dept. for U.S. Fish and Wildlife Service; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:236520-A)
14705	Hutchinson, C. (1970) Bioassay Report: Acute Toxicity of RE-12420 to Three Species of Freshwater Fish. (Unpublished study re- ceived Jun 21, 1972 under 239-EX-61; prepared by Bionomics, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL: 223505-AJ)
14706	Thompson, J.P. (1971) Fish Toxicity: Bluegill (?~Lepomis macro?~- ?~chirus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AK)

14707 Thompson, J.P. (1971) Fish Toxicity: Large Mouth Black Bass (?~Micropterus salmoides?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AL)

14708 Thompson, J.P. (1971) Fish Toxicity: Channel Catfish (?~Ictiobus~ ?~cyprinellus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AM)

14709 Thompson, J.P.; Huntoon, R.B. (1971) Fish Toxicity: Mosquito Fish (?~Gambusia affinis?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Rich- mond, Calif.; CDL:223505-AN)

14710 Thompson, J.P.; Huntoon, R.B. (1971) Fish Toxicity: Goldfish (?~Carassius auratus?~). (Unpublished study received Jun 21, 1972 under 239-EX-61; submitted by Chevron Chemical Co., Rich- mond, Calif.; CDL:223505-AO)

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93938 Buckner, C.H.; McLeod, B.B.; Lidstone, R.G. (1976) Environmental Impact Studies of Spruce Budworm (Choristoneura fumiferana Clemens) Control Programmes in New Brunswick in 1976: Information Report CC-X-135. (Canada, Forestry Service, Chemical Control Research Institute; unpublished study; CDL:246665-E)

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MRID	Citation Reference
46173203	Porch, J.; Kruegger, H.; Martin, K. (2003) Orthene Turf, Tree & Ornamental Spray 97: A Tier II Toxicity Test to Determine the Effects of the Test Substance on Seedling Emergence of Ten Species of Plants. Project Number: VP/26041, 263/150. Unpublished study prepared by Wildlife International, Ltd. 108 p.

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MRID	Citation Reference
46173204	Porch, J.; Kruegger, H.; Martin, K. (2003) Orthene Turf, Tree & Ornamental Spray 97: A Toxicity Test to Determine the Effects of the Test Substance on Vegetative Vigor of Ten Species of Plants. Project Number: VP/26059, 263/151. Unpublished study prepared by Wildlife International, Ltd. 137 p.

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5000837 Johansen, C.A. (1972) Toxicity of field-weathered insecticide residues to four kinds of bees. Environmental Entomology 1(3):393-394.

141- 3 Non Target Beneficial Insect Toxicity

5004012 Plapp, F.W., Jr.; Bull, D.L. (1978) Toxicity and selectivity of some insecticides to~Chrysopa carnea?~, a predator of the tobacco budworm. Environmental Entomology 7(3):431-434.

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850.4400 Aquatic plant toxicity test using Lemna spp. Tiers I and II

MRID	Citation Reference
4887 9503	Burlingham, J. J. 2012. Acephate technical: higher plant (*Lemna*) growth inhibition test. Study performed by Huntingdon Life Sciences, Eye Research Centre, Eye, Suffolk, UK. Study number ADB0073. Study sponsored by Consumer Specialty Products Association, Inc. for the Acephate Task Force Steering Committee/Joint Venture, Washington, D.C. Study completed 03 July 2012.
48879504	Burlingham, J. J. 2012. Methamidophos: Higher Plant (*Lemna*) Growth Inhibition Test. Study performed by Huntingdon Life Sciences, Eye Research Centre, Eye, Suffolk, UK. Study number ADB0081. Study sponsored by Consumer Specialty Products Association, Inc. for the Acephate Task Force Steering Committee/Joint Venture, Washington, DC. Study completed 03 July 2012.

850.5400 Algal toxicity, Tiers 1 and II

MRID	Citation Reference
48879501	Burlingham, J. J. 2012. Acephate Technical: Algal Growth Inhibition Assay (*Pseudokirchneriella subcapitata*). Study performed by Huntingdon Life Sciences Eye Research Centre, Eye, Suffolk, UK. Study number ADB0072. Study sponsored by Consumer Specialty Products Association, Inc., for the Acephate Task Force Steering Committee/Joint Venture, Washington, DC. Study completed 03 July 2012.
48879502	Burlingham, J.J. 2012. Methamidophos: Algal Growth Inhibition Assay (*Pseudokirchneriella subcapitata*). Study performed by Huntingdon Life Sciences, Eye Research Center, Eye, Suffolk, UK. Study number ADB0080. Study sponsored by Consumer Specialty Products Association, Inc. for the Acephate Task Force Steering Committee/Joint Venture, Washington, DC. Study completed 03 July 2012.

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14703 Rausina, G. (1972) Report to Chevron Chemical Company, Ortho Di- vision: 21-Day Perching Bird Dermal Toxicity Study with Orthene 75S in English Sparrows: IBT No. A776. (Unpublished study re- ceived Jun 21, 1972 under 239-EX-61; prepared by Industrial Bio-Test Laboratories, Inc., submitted by Chevron Chemical Co., Richmond, Calif.; CDL:223505-AH)

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5019479 Dirimanov, M. 1976. Effects on potatoes of some insecticides.

40504829 Schreckengast, G.; Kreuges, M.; Jabea, M. (1988) Orthene Tobacco Insect Spray: A Residue Monitoring Study in Tobacco to Assess Exposure to Avian Species ...: WIL Project No. 162-173. Unpublished study performed by Wildlife International. 102 p.

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Johnson, G.; Wallace, M.; Kreuger, H.; et al. (1988) Orthene 75S Soluble Powder: A Residue Monitoring Study in Cotton to Assess Exposure to Avian Species Under Standard Agricultural Use Condi- tions in Alabama: Project ID: WIL Project No. 162-172; Study No. S-2980. Unpublished study prepared by Wildlife Internation- al. 139 p.

APPENDIX D. Ecotoxicity Data

1 Ecotoxicity Study Data Sources

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (USEPA, 2004). Open literature data presented here were obtained from previous acephate and methamidophos assessments as well as ECOTOX information obtained on August 17, 2011 and again on April 30, 2104 (USEPA, 2006; USEPA, 2007a; USEPA, 2007b, USEPA, 2011). In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

(1) the toxic effects are related to single chemical exposure;
(2) the toxic effects are on an aquatic or terrestrial plant or animal species;
(3) the toxic effects are biological effects on live, whole organisms;
(4) a concurrent environmental chemical concentration/dose or application rate is reported; and
(5) an explicit duration of exposure exists.

Open literature toxicity data for other 'target' insect species (not including bees, butterflies, beetles, and non-insect invertebrates including soil arthropods and worms), which include efficacy studies, are generally not considered in deriving the most sensitive endpoint for terrestrial insects due to the study design. For example, efficacy studies do not typically provide endpoint values that are useful for risk assessment (*e.g.*, NOAEC, EC_{50}, *etc.*), but rather are intended to identify a dose that maximizes a particular effect (*e.g.*, EC_{100}).

Data that passed the ECOTOX screen were evaluated along with the registrant-submitted data, and incorporated qualitatively or quantitatively as needed into risk assessment, as specified by the Agency's guidance on the evaluation of open literature (USEPA, 2011b). In general, effects data in the open literature that were more conservative than the registrant-submitted data were considered. The degree to which open literature data were quantitatively or qualitatively characterized for the effects determination was dependent on whether the information was relevant to typically used assessment endpoints (*i.e.*, survival, reproduction, and growth). For example, endpoints such as behavior modifications were likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth were not available.

A complete list of available toxicity data for acephate and its methamidophos degradate is summarized for each taxon in the appropriate sections that follow.

Note: The bold rows in the tables below indicate values used quantitatively in the risk assessment. If the value used was not the most sensitive in the table, the reason was given in a footnote. Also, values for quantitative use are bolded for both acephate and methamidophos toxicity endpoints, although risk calculations from only one or the other (the one with highest risk quotients) are presented in the risk assessment.

2 Toxicity to Freshwater Aquatic Animals

2.1 Freshwater Fish, Acute

2.1.1 Studies using the parent chemical, acephate

Table D.44. Freshwater Fish Acute Toxicity for Acephate					
Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout 1.1 g (static) *(Oncorhynchus mykiss)* 17 °C, pH 7.4, 40 mg/L $CaCO_3$	97	>100[1]	practically non-toxic	40098001 Mayer, 1986	supplemental

Table D.44. Freshwater Fish Acute Toxicity for Acephate					
Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout (static) *(O. mykiss)*	technical	>1000	practically non-toxic	00014705 Hutchinson, 1970	acceptable
Rainbow trout 0.2 g (static) (*O. mykiss*), 12 °C, pH 7.4, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Rainbow trout 0.2 g (static) (*O. mykiss*), 12 °C, pH 7.4, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Rainbow trout 0.9 g (static) (*O. mykiss*), 12 °C, pH 7.4, 40 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Rainbow trout 0.9 g (static) (*O. mykiss*), 12 °C, pH 7.4, 320 mg/L $CaCO_3$	94	>1000	practically non-toxic	40098001 Mayer, 1986	supplemental
Rainbow trout 1.0 g (static) (*O. mykiss*), 12 °C, pH 6.5, 40 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Rainbow trout 1.0 g (static) (*O. mykiss*), 12 °C, pH 8.5, 40 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Rainbow trout 1.5 g (static) *(O. mykiss*), 10 °C, pH 7.4, 40 mg/L $CaCO_3$	94	832[2]	practically non-toxic	40094602 Johnson, 1980 40098001 Mayer, 1986	supplemental
Rainbow trout 12.9 g (flow-through) *(O. mykiss*), 15°C, pH 6.5	**92[3]**	**852 (95% CI 598-1213)**	**practically non-toxic**	**48650401 ECOTOX #7317 Duangsawasdi, 1977**	**supplemental**
Fathead Minnow (static) *(Pimephales promelas)*	94	>1000	practically non-toxic	40094602 Johnson, 1980	supplemental
Bluegill sunfish (static) *(Lepomis macrochirus)*	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Bluegill sunfish (static) *(L. macrochirus)*	94	>1000	practically non-toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon yolk-sac fry (static) (*Salmo salar*), 7 °C, pH 7.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 7 °C, pH 7.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 17 °C, pH 7.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 12 °C, pH 7.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 12 °C, pH 7.5, 12 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 12 °C, pH 7.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 12 °C, pH 6.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Atlantic salmon 0.2 g (static) (*S. salar*), 12 °C, pH 8.5, 40 mg/L $CaCO_3$	97	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.2 g (static) (*Salvelinus fontinalis*), 12 °C	94	>100	practically non-toxic	40094602 Johnson, 1980	supplemental

Table D.44. Freshwater Fish Acute Toxicity for Acephate					
Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Brook trout 1.5 g (static) (*S. fontinalis*), 12 °C, pH 7.5, 42 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout, 0.7 g (static) (*Oncorhynchus clarki*), 12 °C, pH 7.5, 42 mg/L $CaCO_3$	94	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout, 0.8 g (static) (*O. clarki*), 12 °C, pH 7.8 42 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout, 0.9 g (static) (*O. clarki*), 7 °C, pH 7.5, 42 mg/L $CaCO_3$	94	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout, 0.9 g (static) (*O. clarki*), 12 °C, pH 8.5, 42 mg/L $CaCO_3$	94	>60	at most slightly toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout, 1.0 g (static) (*O. clarki*), 12 °C, pH 6.5, 42 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout, 1.0 g (static) (*O. clarki*), 12 °C, pH 7.8, 330 mg/L $CaCO_3$	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout (static) (*O. clarki*)	94	>100	practically non-toxic	00120401 Woodward, 1980	supplemental
Yellow perch (static) (*Perca flavescens*)	94	>50	at most slightly toxic	40098001 Mayer, 1986	supplemental
Channel Catfish 2.0 g (static) (*Ictalurus punctatus*), 22 °C, pH 7.4, 40 mg/L $CaCO_3$	94	>1000	practically non-toxic	40094602 Johnson and Finley, 1980 40098001 Mayer, 1986	supplemental
Goby (*Synechogobius hasta*)	98.4	40.1		ECOTOX #163150 Liu,, *et al.* (2013)	supplemental

[1] This study had a reported LC_{50} of 110 mg/L (95% CI: 63-190) but did not achieve 50% mortality at any concentration. Therefore, this endpoint was not used quantitatively.
[2] Evaluation of this data using ToxAnal gives an LC_{50} of 832 mg/L using the binomial method. This endpoint was not used quantitatively due to use of only 5 fish per treatment level, no replication, and no mortality below the highest test concentration. The reported LC_{50} in the original report by Mayer & Ellersieck calculated the LC_{50} as 1100 mg/L (95% CI: 775-1561).
[3] Technical grade soluble powder.

Table D.45. Freshwater Fish Acute Toxicity for Acephate Formulations					
Species	% ai[1]	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout 1.2 g (static) (*O. mykiss*), 10 °C, pH 7.4, 40 mg/L $CaCO_3$	75 WP	730 (95% CI 580- 920)[2]	practically non-toxic	40094602 Johnson and Finley, 1980 40098001 Mayer, 1986	supplemental
Rainbow trout (static) (*O. mykiss*)	75	2740	practically non-toxic	ECOTOX #11133 Geen et al., 1984	supplemental
Bluegill sunfish (static) (*L. macrochirus*)	75	2000[4]	practically non-toxic	00014706 Thompson, 1971	acceptable
Bluegill sunfish (static) (*L. macrochirus*)	75 WP	>200	practically non-toxic	40098001 Mayer, 1986	supplemental
Bluegill sunfish (static) (*L. macrochirus*)	75 WP	>1000	practically non-toxic	40094602 Johnson, 1980	supplemental
Brook trout 0.2 g (static) (*S. fontinalis*), 12 °C, pH 6.5, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.2 g (static) (*S. fontinalis*), 12 °C, pH 7.5, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental

Table D.45. Freshwater Fish Acute Toxicity for Acephate Formulations					
Species	% ai[1]	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Brook trout 0.2 g (static) (*S. fontinalis*), 12 °C, pH 8, 12 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.2 g (static) (*S. fontinalis*), 12 °C, pH 8, 44 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.2 g (static) (*S. fontinalis*), 12 °C, pH 8, 300 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.2 g (static) (*S. fontinalis*), 12 °C, pH 9, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.7 g (static) (*S. fontinalis*), 7 °C, pH 7.5, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 0.7 g (static) (*S. fontinalis*), 17 °C, pH 7.5, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 1.0 g (static) (*S. fontinalis*), 7 °C, pH 7.5, 40 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Brook trout 1.0 g (static) (*S. fontinalis*), 17 °C, pH 7.5, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Largemouth bass (static) (*Micropterus salmoides*)	75	3000[5]	practically non-toxic	00014707 Thompson, 1971	supplemental
Cutthroat trout 0.9 g (static) (O. clarki), 12 °C, pH 7.5, 42 mg/L $CaCO_3$	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Cutthroat trout (static) (*O. clarki*)	75	>100	practically non-toxic	00120401 Woodward, 1980	supplemental
Gold fish (static) (*Carassius auratus*)	75	>4000[6]	practically non-toxic	00014710 Thompson, 1971	supplemental
Yellow perch (static) (*P. flavescens*)	75 WP	>100	practically non-toxic	40098001 Mayer, 1986	supplemental
Channel Catfish, 0.5 g (static) (*Ictiobus cyrinallus*)	75 WP	(95% CI 560-1000)	practically non-toxic	40094602 Johnson and Finley, 1980 40098001 Mayer, 1986	supplemental
Channel Catfish (static) (*I. cyrinallus*)	75	1500[7]	practically non-toxic	00014708 Thompson, 1971	acceptable
Fathead Minnow 1.0 g (static) (*P. promelas*), 20 °C, pH 7.4, 40 mg/L $CaCO_3$	75 WP	>1000	practically non-toxic	40098001 Mayer, 1986	supplemental
Fathead Minnow 1.0 g (static) (*P. promelas*), 20 °C, pH 7.4, 40 mg/L $CaCO_3$	75 WP	>1000	practically non-toxic	40098001 Mayer, 1986	supplemental
Mosquito fish (static) (*Gambusia affinis*)	75	6000[8]	practically non-toxic	00014709 Thompson, 1971	supplemental

[1] WP = wettable powder
[2] This study did not use a control. Therefore, this endpoint was not used in the risk assessment.
[4] There was 100% mortality at 8,000 mg ai/L. No mortality at 500 mg ai/L
[5] There was 100% mortality at 4,000 mg ai/L. No mortality at 500 mg ai/L
[6] No mortality at 1000 and 2000 mg ai/L
[7] No mortality at 1000 mg ai/L
[8] No mortality at 4000 mg ai/L

Freshwater fish acute toxicity studies with technical grade acephate classify acephate as practically non-toxic (LC_{50} >100 mg a.i./L) to freshwater fish species, or at most slightly toxic (LC_{50} = >10-100), on an acute exposure basis.

Similarly, freshwater fish acute toxicity studies with formulated acephate classify acephate as practically non-toxic (LC_{50} >100 mg a.i./L) to freshwater fish species on an acute exposure basis.

Acephate technical grade active ingredient (TGAI) acute toxicity data exist for several cold water and warm water freshwater fish species, including rainbow trout (*Oncorhynchus mykiss*), bluegill sunfish (*Lepomis macrochirus*), brook trout (*Salvelinus fontinalis*), Atlantic salmon (*Salmo salar*), cutthroat trout (*Oncorhynchus clarki*), yellow perch (*Perca flavescens*), channel catfish (*Ictalurus punctatus*), and fathead minnow (*Pimephales promelas*). A complete list of all the acute freshwater fish toxicity data for acephate is provided above. In 32 studies, the acute freshwater fish 96-h LC_{50} values for technical grade acephate range from >50 to >1,000 mg a.i./L and of these studies only two have definitive 96-h LC_{50} values.

The most sensitive **LC_{50}** value suitable for use in RQ calculations was **852 mg a.i./L** for the rainbow trout (MRID 48650401, ECOTOX 7317, Duangsawasdi, 1977). This study used a 93% technical grade soluble powder and tested 10 concentrations with 10 fish at each test level. The study species were larger than recommended by the US EPA guideline and the study was conducted at 15±1°C, warmer than the recommended 12±2°C. However, the study experienced very low pre-test and control mortality indicating that the temperature did not cause stress to the fish.

One lower freshwater fish 96-h LC_{50} value was available – 832 mg a.i./L with rainbow trout (MRID 40098001, Mayer and Ellersieck, 1986). Raw data from this study were reviewed and the LC_{50} was calculated. This study was considered to be supplemental and not suitable for use in RQ calculations because of a lack of replicates, the use of only 5 fish per treatment level, the use of only nominal test concentrations, and a lack of chemical, water, and environmental data provided. Further, mortality was only seen at the highest test concentration, resulting in significant uncertainty of the LC_{50} calculation.

Another more sensitive rainbow trout LC_{50} calculated by Mayer and Ellersieck was available, but these data were not considered scientifically sound because mortality of <50% was not achieved at any test concentration. Based on this data, acephate is categorized as slightly toxic to practically non-toxic to freshwater fish on an acute exposure basis. A complete list of all the acute freshwater fish toxicity data for acephate is provided above.

Acephate formulation (75% wettable powder) acute toxicity test results were also available for several cold water and warm water freshwater species including rainbow trout (*O. mykiss*), bluegill sunfish (*L. macrochirus*), brook trout (*S. fontinalis*), largemouth bass (*Micropterus salmoides*), cutthroat trout (*O. clarki*), goldfish (*Carassius auratus*), yellow perch (*P. flavescens*), channel catfish (*I. punctatus*), fathead minnow (*P. promelas*), and mosquito fish (*Gambusia affinis*). For these 25 studies the 96-h LC_{50} values range from >100 to 6,000 mg a.i./L Like the studies with acephate TGAI, most of these LC_{50} values were non-definitive values. However, based on the limited data it did not appear that acephate as the 75% wettable powder formulation was more toxic than the TGAI.

2.1.2 Studies using the degradate, methamidophos

Table D.46. Freshwater Fish Acute Toxicity for Methamidophos					
Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Carp (static) *(Cyprinpus carpio)*	90	68[1]	slightly toxic	05008361 Chin, 1979	supplemental
Rainbow trout (static) *(O. mykiss)*	**74[2]**	**25 (21-29)**	**slightly toxic**	**00041312 Nelson & Roney, 1979**	**acceptable**

[1] Sublethal doses affect growth rate of carp. Brain and liver acetylcholinesterase activities were depressed at20 mg a.i./L concentrations for 48 hours.
[2] Study was previously listed as a formulation study; however, even though the a.i. was only 74%, the test substance used was a technical product.

This freshwater fish acute toxicity study with technical grade methamidophos classified methamidophos as slightly toxic (LC_{50} = >10-100 mg a.i./L) to freshwater fish species on an acute exposure basis.

There was only one acute 96-h LC_{50} study with a freshwater fish and the major degradate, methamidophos TGAI, which was with a warm water carp (*Cyprinus carpio*). The 96-h LC_{50} was 68 mg a.i./L methamidophos for the carp.

In this study, brain and liver acetylcholinesterase activities were depressed at 20 mg a.i./L concentrations for 48 hours. Methamidophos TGAI toxicity to the carp was higher than the 96-h LC_{50} value observed for acephate with rainbow trout (852 mg a.i./L). A more sensitive endpoint was found with the rainbow trout (*O. mykiss*) from a study previously listed as a formulation study; however, even though the a.i. was only 74%, the test substance used was a technical product with no listed inert ingredients (OPPIN querry, September 25, 2014). Toxicity was attributable to methamidophos toxicity. The **methamidophos 96-h LC_{50}** from this study was **25 mg a.i./L**, whereas for the same species the acephate TGAI results ranged from >50 to >1,000 mg a.i./L and for acephate formulations 730 to 2,740 mg a.i./L

2.2 Freshwater Fish, Chronic

Since there were no chronic data for freshwater fish with survival, growth, or reproductive endpoints submitted to US EPA or located in the open literature, an acute to chronic ratio (ACR) was determined using other organophosphate insecticide data. The estimated chronic **NOAEC** for rainbow trout, as derived from an ACR of 144 and an LC_{50} of 852 mg a.i./L, was **5.9 mg a.i./L**. The following methodology was used to derive this ACR and chronic fish NOAEC. The freshwater fish early life stage NOAEC endpoint was used as a surrogate for the aquatic-phase amphibian (U.S. EPA 2006).

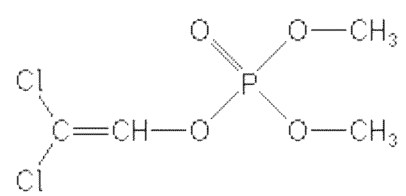
Table D.47. Acephate Acute-to-Chronic Ratio for Rainbow Trout NOAEC.

Chemical	96-hr LC_{50} (mg ai/L)	MRID	NOAEC (mg ai/L)	MRID	ACR	Acephate NOAEC (mg ai/L)	Methamidophos NOAEC (mg ai/L)
Azinphos methyl	0.0088	03125193	0.00029	00145592	30.34	28.08	0.82
Coumaphos	0.890	40098001	0.0117	43066301	76.07	11.20	0.33
Dichlorvos	0.750	43284702	0.0052	43788001	144.23	5.91	0.17
Dimethoate	7.500	TN 1069[1]	0.430	43106303	17.44	48.85	1.43
Disulfoton	1.850	40098001	0.220	41935801	8.41	101.32	2.97
Fenamiphos	0.068	40799701	0.0038	41064301	17.89	47.61	1.40
Fenitrothion	2.000	40098001	0.046	40891201	43.48	19.60	0.58
Fenthion	0.830	40214201	0.0075	40564102	110.66	7.70	0.23
Fonofos	0.050	00090820	0.0047	40375001	10.64	80.09	2.35
Isofenphos	1.800	00096659	0.153	00126777	11.76	72.42	2.13
Phosmet	0.105	40098001	0.0032	40938701	32.81	25.97	0.76
Terbufos	0.0076	40098001	0.0014	41475801	5.43	156.95	4.61

[1] TN 1069 was test number for EPA's Animal Biology Lab, McCann, 1977.

The EFED toxicity database was accessed to derive an acute to chronic ratio for all organophosphate insecticides that have an acute LC_{50} for rainbow trout, an early life stage fish study for rainbow trout, and have been reviewed previously for scientific soundness (acceptable and supplemental studies). Twelve organophosphates met these criteria. Rainbow trout is typically the most sensitive fish species to pesticides and is the most sensitive fish acute endpoint for acephate. The ACR ranged from 5.4 for terbufos to 144.0 for dichlorvos (**Error! Reference source not found.**). In order to provide the most conservative estimate for the chronic freshwater fish NOEAC for acephate, the ACR of 144 was used. The calculation was as follows:

Dichlorvos (DDVP) Chemical Structure



ACR for Dichlorvos: 750 ppb a.i. (acute LC_{50}) / 5.2 ppb a.i. (chronic NOAEC) = 144

Estimated NOAEC for acephate = $\frac{LC_{50}}{}$ = $\frac{852 \text{ mg a.i./L}}{}$ = 144

NOAEC NOAEC

Estimated NOAEC for acephate = 852/144 = **5.9 mg a.i./L**

As with acephate, no chronic freshwater fish studies have been submitted to EPA or identified in the open literature for methamidophos. Therefore, an ACR (utilizing the same methods as described above) was used to estimate a methamidophos NOAEC for freshwater fish. The calculation was as follows:

$$\text{Estimated NOAEC for methamidophos} = \frac{LC_{50}}{\text{NOAEC}} = \frac{25 \text{ mg a.i./L}}{\text{NOAEC}} = 144$$

Estimated Trout NOAEC for methamidophos = 25/144 = **0.17 mg a.i./L**

2.3 Freshwater Fish: Sublethal Effects and Additional Open Literature Information

Sublethal effects of acephate and methamidophos exposure to freshwater fish were reported in open literature studies. One study (Zinkl, 1987) found that >70% cholinesterase (ChE) inhibition was needed to achieve poisoning by acephate or methamidophos to rainbow trout, as brain ChE inhibition was as high as 70% in trout that survived exposure. Persistent ChE depression was evident (brain ChE activity remains depressed 8 days after a 24-hour exposure to 25 mg/L of methamidophos and 15 days after exposure to 400 mg/L of acephate), which suggests sublethal effects such as inability to sustain physical activity in search of food, eluding predators, and maintaining position in flowing water would occur.

Liu,, *et al.* (2013; ECOTOX No. 163150) calculated a 96-h acephate LC_{50} of 40.1 mg/L based on mortality and a 96-h LOAEC of 5.0 mg/L based on acetylcholinesterase (33.6% reduction) and 29.2-57.5% change in catalase enzymes, for the goby (*Synechogobius hasta*). The publication did not provide enough information to be able to quantitatively tie the enzymatic activity to growth, survival or reproduction but supported the endpoint of 5.9 mg a.i./L calculated above using an ACR.

Several studies (Boscor, 1975, MRID 14637; Geen, 1981; Rabeni, 1979, MRID 14547; Schoettger, 1976, MRID 14861) indicated no significant adverse effects on fish and benthic invertebrates from tested acephate concentrations.

2.4 Amphibians

2.4.1 Studies using the parent chemical, acephate

Table D.48. Amphibian Acute Toxicity for Acephate

Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Green frog larvae/tadpole (*Rani clamitans*)	90	6433 (24 hr)	practically non-toxic	00093943, 05019255 Lyons, 1976	supplemental[1]
Frog larvae (*Rani catesbelana*)	98	>5	NA[2]	44042901 Hall, 1980	supplemental[1]
Salamander larvae (*Ambystoma gracile)*	97	8816 (96 hr)	practically non-toxic	ECOTOX #11134 Geen et al., 1984	supplemental[1]

[1] Supplemental study due to no available FIFRA test guideline and no raw data for statistical analysis.
[2] This study tested for bio-concentrations to amphibians. Neither bio-accumulation nor toxicity were noted.

2.4.2 Open Literature Studies

Using the acute aquatic organism ecotoxicity categories, acephate is classified as practically non-toxic to aquatic-phase amphibians on an acute basis. The most sensitive acephate amphibian study calculated a 24 hr **LC_{50}** for green frog larvae/tadpoles at **6433 mg/L** (95% CI: 5857-6775) (MRIDs 00093943, 05019255, Lyons, 1976). This study was classified as supplemental and has been deemed suitable for quantitative use in risk assessments. Note that there was no EPA guideline for amphibian studies. The study did not provide raw data, uses only ten tadpoles per treatment level, and lacks replicates. Although the study was run for 96 hrs, only a 24 hr toxicity endpoint was derived because a linear dose-response pattern was not obtained. A behavior bioassay suggested that concentrations up to 500 mg/L produced no observable differences between the treatment and control groups.

Another study tested green frog larvae/tadpoles with acephate up to 5 mg/L for bio-concentration (MRID 44042901, Hall, 1980). Neither bio-accumulation nor toxicity was noted at 5 mg/L.

A salamander acephate study found a 96 hr LC_{50} of 8816 mg/L (ECOTOX 11134, Geen, 1984). Exposure of egg masses to acephate concentrations of 798 mg/L did not show any significant differences from the control to the time of hatching. This study was classified as supplemental and appropriate for qualitative use only.

2.5 Freshwater Invertebrates, Acute

2.5.1 Studies using the parent chemical, acephate

Table D.49. Freshwater Invertebrate Acute Toxicity for Acephate

Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Mayfly larvae, age not reported *Ephemerida*	98	3.2 (24 hr)[1]	N/A	ECOTOX #37219 Hussain et al. 1985	supplemental
Stonefly 1st year class (*Pteronarcella badia*), 12°C, pH 6.5, 40 mg/L $CaCO_3$, static	94	6.4 (95% CI 5.3-7.8)	moderately toxic	40098001 Mayer, 1986	supplemental
Stonefly, 1st year class (*P. badia*)	94	9.5	moderately toxic	00120401 Woodward, 1980	supplemental
Stonefly, 1st year class (*P. badia*), 12°C, 7.5 pH, 38 mg/L $CaCO_3$	94	9.5 (95% CI 7.3-12.3)	moderately toxic	40098001 Mayer, 1986, 40094602 Johnson, and Finley 1980	supplemental
Stonefly, 1st year class, 12°C, pH 8.5, 38 mg/L $CaCO_3$, static	94	21.2 (95% CI 15.6-28.2)	slightly toxic	40098001 Mayer 1986	supplemental
Stonefly, 1st year class (*Isogenus* sp.), 7 °C, pH 7, 35 mg/L $CaCO_3$, static	94	11.7 (95% CI 8.7-15.8)	slightly toxic	40098001 Mayer, 1986	supplemental
Stonefly, naiad (*Skwala* sp.), 7 °C, 40 mg/L $CaCO_3$, static	95	12 (95% CI 8.7-16)	slightly toxic	40094602 Johnson and Finley, 1980	supplemental
Stonefly larvae, age not reported Plecoptera	98	37 (24 hr)[1]	N/A	ECOTOX #37219 Hussain et al. 1985	supplemental
Water-boatman, adults Corixidae	98	8.2 (24 hr)	moderately toxic	ECOTOX #11371 Hussain et al. 1984	supplemental
Backswimmer, adults Notonectidae	98	10.4 (24 hr)	slightly toxic	ECOTOX #11371 Hussain et al. 1984	supplemental
Waterflea *(Daphnia magna)*	98	71.8 (48 hr EC_{50}) (95% CI 62.9 – 81.7) Slope = 6.3	slightly toxic	00014565 Wheeler, 1978	acceptable
Scud, mature (*Gammarus pseudolimneaus*), 12°C 40 mg/L $CaCO_3$, static	94	>50 (48 hr)	at most slightly toxic	40094602 Johnson and Finley, 1980 40098001 Mayer, 1986	supplemental
Scud, mature (*G. pseudolimneaus*), 12°C, static, 320 mg/L $CaCO_3$	94	>50 (48 hr)	at most slightly toxic	40098001 Mayer, 1986	supplemental
Scud (*G. pseudolimneaus*)	94	>100	practically non-toxic	00014861, 05018314 Schoettger, 1970	acceptable

Midge, 4th instar (*Chironomus plumosus*), 20°C, static	94	>1000	practically non-toxic	40094602 Johnson and Finley, 1980	supplemental
Midge, 3rd instar (*C. plumosus*), 17°C, pH 7.4, 40 mg/L $CaCO_3$, static	94	>50 (48 hr EC_{50})	at most slightly toxic	40098001 Mayer, 1986	supplemental
Midge, 3rd instar (C. plumosus), 17°C, pH 7.4, 320 mg/L $CaCO_3$, static	94	>50 (48 hr EC_{50})	at most slightly toxic	40098001 Mayer, 1986	supplemental
Damselfly larvae, age not reported Zygoptera	98	140 (24 hr LC_{50})[1]	N/A	ECOTOX #37219 Hussain et al. 1985	supplemental
Mosquito, 3rd instar (*Aedes aegypti*)	98	650 (24 hr LC_{50})[1]	N/A	ECOTOX #37219 Hussain et al. 1985	supplemental

[1] Mean of two tests (Note: author did not report if the mean was a geometric or arithmetic mean).

These freshwater invertebrate acute toxicity studies with technical grade acephate classify acephate as practically non-toxic (LC_{50} >100 mg a.i./L) to moderately toxic (LC_{50} = >1-10 mg a.i./L) to freshwater invertebrate species on an acute exposure basis.

Table D.50. Freshwater Invertebrate Acute Toxicity for Acephate Formulations					
Species	% ai[1]	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea ***(D. magna)***	**75 WP**	**1.11 (48 hr EC_{50}) (95% CI 0.65-1.88) Slope = 1.62**	**moderately toxic**	**47116601 Thompson, 1978**	**acceptable**
Stonefly, 1st year class *(Isogenus* sp.), 7 °C, pH 7.5, 42 mg/L $CaCO_3$, static	75 WP	12 (95% CI 8.0-17.9)	slightly toxic	40098001 Mayer, 1986	supplemental
Stonefly, naiad (*Skwala* sp.), 7 °C, static, 40 mg/L $CaCO_3$, static	75 WP	12 (95% CI 8.0 – 18)	slightly toxic	40094602 Johnson and Finley, 1980	supplemental
Midge, 3rd instar (*C. plumosus*), 20 °C, pH 7.2, 40 mg/L $CaCO_3$, static	75 WP	>1000 (48 hr EC_{50})[2]	practically non-toxic	40098001 Mayer, 1986	supplemental
Crayfish *(Procamborus clarki)*	75	120-h LC_{50} >750 No mortality	practically non-toxic	00014712 Sleight, 1972	supplemental

[1] WP = wettable powder
[2] Additionally, three tests with the same environmental conditions were conducted using solutions aged 1, 3, and 7 days prior to test initiation. The 48-h EC_{50} values were >1000 mg a.i./L (initial concentration) for each test.

These freshwater invertebrate acute toxicity studies with formulated acephate classify acephate as practically non-toxic (LC_{50} >100 mg a.i./L) to moderately toxic (LC_{50} = >1-10 mg a.i./L) to freshwater invertebrate species on an acute exposure basis. A complete list of all the acute freshwater invertebrate toxicity data for acephate is provided above.

The most sensitive acephate freshwater invertebrate study found the 48 hr **EC_{50}** for *Daphnia magna* to be **1.11 mg a.i./L** (95% CI: 0.65-1.88) (MRID 47116601, Thompson, 1978). The probit slope was 1.62. The range of EC_{50} toxicity for freshwater invertebrates in 24 studies using both acephate TGAI and formulations was 1.11 to >1,000 mg a.i./L. Only one other study used *D. magna*; this study found a 48 hr EC_{50} of 71.8 mg a.i./L. Other studies on freshwater invertebrates use species including mayfly (Ephemerida), stonefly (Plecoptera), scud (*Gammarus pseudolimneaus*), midge (*Chironomus plumosus*), damselfly (*Zygoptera*), and crayfish (*Procamborus clarki*).

2.5.2 Studies using the degradate, methamidophos

Table D.51. Freshwater Invertebrate Acute Toxicity for Methamidophos					
Species	% ai	48-hour LC_{50}/ EC_{50} (mg/L) (95% CI)	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea	**74**	**0.026 (0.20–0.034)**	**very highly toxic**	**00041311**	**acceptable**

Table D.51. Freshwater Invertebrate Acute Toxicity for Methamidophos					
(D. magna)				**Nelson & Roney 1979**	
Waterflea *(D. magna)*	72	0.050 (0.040-0.070)	very highly toxic	00014110 Wheeler 1978	acceptable
Waterflea *(D. magna)*	74	0.027 (0.014-0.053)	very highly toxic	00014305 Nelson & Roney 1977	supplemental[1]
Waterflea *(D. magna)*	99	0.034	very highly toxic	ECOTOX #99572 Lin et al., 2006	open literature study

[1] Due to temperature of 24°C instead of 18 °C.

These freshwater invertebrate acute toxicity studies with formulated methamidophos classify methamidophos as very highly toxic (LC_{50} <0.1 mg/L) to freshwater invertebrate species on an acute exposure basis. A complete list of all the acute freshwater invertebrate toxicity data for methamidophos is provided above.

The methamidophos RED (1998) includes a freshwater prawn (*Macrobrachium rosenbergii*) study classified as supplemental in the above table.[15] This study was not cited here because the study did not meet EPA's validity criteria and has been downgraded to invalid. The study was a static renewal study in which the organisms were handled every 24 hours. During the handling process, mortality occurred. The mortality in the controls ranged from 60% to 80%. EPA's criteria only allows up to 10% mortality in the controls.

The most sensitive methamidophos freshwater invertebrate study found the 48 hr **EC_{50}** for *D. magna* to be **0.026 mg a.i./L** (95% CI: 0.20-0.034) (MRID 41311, Nelson and Roney, 1977). The range of EC_{50} toxicity for freshwater invertebrates in four studies was 0.026 to 0.050 mg/L. All four studies used *D. magna*.

2.6 Freshwater Invertebrates, Chronic

2.6.1 Studies using the parent chemical, acephate

Table D.52. Freshwater Invertebrate Life-Cycle Toxicity for Acephate					
Species	% ai	21-day NOAEC/LOAEC (mg ai/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Waterflea *(D. magna)*	**75 WP**	**0.150/0.375**	**Reduction in numbers of young at 375 ppb and higher**	**44466601 Thompson, 1978**	**supplemental[1]**

[1] This study was classified acceptable in a 1982 review. The study has been downgraded to supplemental because the control had 35% mortality of the adults and the treatments range from 10% to 35% mortality with the highest concentration level having 10% mortality. There was a dose response trend of offspring per adult per day.

This freshwater invertebrate chronic toxicity study with acephate found decreased production of young when parents were exposed to between 0.150 and 0.375 mg a.i./L.

One freshwater invertebrate life-cycle study using acephate was submitted to EPA (MRID 44466601, McCann, 1978) and none were identified in the open literature. The study used *D. magna* and found a **NOAEC** of **0.150 mg a.i./L** in a 21 day test based on reduction in numbers of young. The LOAEC was 0.375 mg a.i./L. This study was classified supplemental because the control had 35% mortality of the adults and the treatments ranged from 10% to 35% mortality for adults with the highest concentration level having 10% mortality. There was a dose response trend of offspring per adult per day. This dose response trend and the more sensitive methamidophos *D. magna* life-cycle **NOAEC** of **0.0045 mg a.i./L** (MRID 46554501, Kern & Lam, 2005, see **Table D.10**.) led to the conclusion that the NOAEC of 0.150 mg a.i./L contained useful information despite the high control mortality.

[15] Juarez, L.M., J. Sanchez, 1989. Toxicity of the Organophosphorous Insecticide Methamidophos (O,S-Dimethyl Phosphoramidothioate) to Larvae of the Freshwater Prawn, *Macrobachium rosenbergii* (DeMan) and the Blue Shrimp, *Penaeus stylirostris* Stimpson. Bull. Environ. Contam. Toxicol. (1989) 43:302-309.

2.6.2 Studies using the degradate, methamidophos

Table D.53. Freshwater Invertebrate Life-Cycle Toxicity for Methamidophos					
Species	% ai	NOEC (mg ai/L)	Endpoints (mg ai/L)	MRID No. Author/Year	Study Classification
Waterflea ***(D. magna)***	**78.5**	**0.0045**	**21-day dry weight** **NOAEC: 0.00449** **LOAEC: 0.00532** **21-day immobility** **NOAEC: 0.0119** **LOAEC: 0.0218** **21-day reproduction endpoint** **NOAEC: 0.00532** **LOAEC: 0.0119**	**46554501** **Kern and Lam, 2005**	**supplemental[1]**

[1] Increasing concentrations of test substance in weekly measurements throughout the study.

This freshwater invertebrate chronic toxicity study with methamidophos indicates that when parents were exposed to between 0.00449 and 0.00532 mg a.i./L methamidophos, production of young was affected.

2.7 Freshwater Invertebrates: Open Literature Data

Data were located in the open literature that report lethal and sublethal effect levels to freshwater invertebrates. However, these studies reported endpoints that were less sensitive than ones already available.

In one study, backswimmer (Notonectidae) ChE exposed to a 0.08 M methamidophos solution *in vitro* remained inhibited in a phosphorylated state for at least 4 hours (ECOTOX 37219, Hussain *et al.*, 1985). A previous study demonstrated the rapid conversion of acephate to methamidophos in the backswimmer (ECOTOX 11371, Hussain *et al.*, 1984). The authors suggested that aquatic insects and fish that were exposed to acephate or methamidophos may not recover by spontaneous reactivation of acetylcholinesterase (AChE) and may therefore be stressed for some time because of physiological effects caused by inhibition of AChE.

3 Toxicity to Estuarine and Marine Aquatic Animals

3.1 Estuarine and Marine Fish, Acute

3.1.1 Studies using the parent chemical, acephate

Table D.54. Estuarine/Marine Fish Acute Toxicity for Acephate					
Species (Static or Flow-through)	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Sheepshead minnow (flow-through) *(Cyprinodon variegatus)*	94	910	practically non-toxic	40228401 Mayer, 1986	supplemental
Sheepshead minnow (static) *(C. variegatus)*	94	>3200 (28 days)	practically non-toxic	40228401 Mayer, 1986	supplemental
Mummichog (static) *(Fundulus heteroclitus)*	75	2872 (m) 3299 (f)	practically non-toxic	ECOTOX #6924 Fulton and Scott, 1991	ancillary
Pin Fish (flow-through) (*Lagodon rhomboides*)	**94**	**85**	**slightly toxic**	**40228401 Mayer, 1986**	**supplemental**

Table D.54. Estuarine/Marine Fish Acute Toxicity for Acephate					
Species (Static or Flow-through)	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Spot (static) (*Leinstomus xanthurns*)	94	>100	practically non-toxic	40228401 Mayer, 1986	supplemental

These estuarine/marine fish acute toxicity studies with acephate classify acephate as practically non-toxic (LC_{50} >100 mg a.i./kg) to slightly toxic (LC_{50} = >10-100 mg a.i./L) to estuarine/marine fish species on an acute exposure basis. A complete list of all the acute estuarine/marine fish toxicity data for acephate is provided above.

Acephate acute toxicity data exist for multiple estuarine/marine fish including sheepshead minnow (*Cyprinodon variegatus*), mummichog (*Fundulus heteroclitus*), pin fish (*Lagodon rhomboides*), and spot (*Leinstomus xanthurns*). In five studies, the acute estuarine/marine fish 96-h LC_{50} values for acephate range from 85 to >3200 mg a.i./L, and of these studies, three had definitive 96-h LC_{50} values. One study used a 75% acephate formulation and the remainder used technical grade acephate. Based on these data, acephate was categorized as practicall y non-toxic to slightly toxic to estuarine/marine fish on an acute exposure basis. The most sensitive study was on the pin fish (*L. rhomboides*) with a 96-h **LC_{50}** of **85 mg a.i./L** (MRID 40228401, Mayer, 1986). No sublethal effects were reported as part of this study. The data was recorded as part of a larger report and classified as supplemental because of a lack of raw data and study specific details.

3.1.2 Studies using the degradate, methamidophos

Table D.55. Estuarine/Marine Fish Acute Toxicity for Methamidophos					
Species	% ai	96-hour LC_{50} (mg ai/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Sheepshead minnow ***(C. variegatus)***	**70.1**	**5.63 (95% CI 4.13-6.89)**	**moderately toxic**	**00144431 Larkin, 1983**	**acceptable**

One estuarine/marine fish acute toxicity study with methamidophos classifies methamidophos as moderately toxic (LC_{50} = >1-10 mg a.i./L) to estuarine/marine fish species on an acute exposure basis. The 96-h LC_{50} study with the sheepshead minnow (MRID 144431, Larkin, 1983) had a 96-h **LC_{50}** value of **5.63 mg a.i./L** (95% CI: 4.13-6.89) methamidophos, lower than the most sensitive 96-h LC_{50} value observed for acephate (pin fish, 85 mg a.i./L).

3.2 Estuarine and Marine Fish, Chronic

No chronic toxicity studies for estuarine/marine fish for either acephate or methamidophos have been submitted by registrants or identified in the ECOTOX database.

If the same acute-to-chronic ratio used for freshwater fish, 144 (above), was applied to estuarine/marine fish, the estimated chronic toxicity value would be 0.59 mg/L for acephate and 0.039 mg/L for methamidophos. This approach involves a great deal of uncertainty due to the extrapolation from one chemical to a different chemical and from freshwater fish to estuarine/marine fish. Therefore, these values were not used to quantitatively estimate risk in this assessment.

3.3 Estuarine and Marine Invertebrates, Acute

3.3.1 Studies using the parent chemical, acephate

Table D.56. Estuarine/Marine Invertebrate Acute Toxicity for Acephate					
Species (Static or Flow-through)	% ai	96-hour LC_{50} (mg/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (embryo-larvae) *(Crassostrea virginica)*	89	5.41 (48 hr) (95% CI 3.3 – 8.9)	moderately toxic	00014713 Sleight, 1970	acceptable
Eastern oyster (embryo-larvae) (static) *(C. virginica)*	94	150	practically non-toxic	40228401 Mayer, 1986	supplemental
Mysid *(Americamysis bahia)* (flow-through)	94	7.3	slightly toxic	40228401 Mayer, 1986	supplemental
Brown shrimp (*Penaeus aztecus*)	89	22.9 (48 hr) (95% CI 9.5 – 54.9)	slightly toxic	00014711 Sleight, 1970	supplemental
Pink Shrimp (flow-through) (*Penaeus duorarum*)	**94**	**3.8**	**moderately toxic**	**40228401 Mayer, 1986**	**supplemental**
Pink Shrimp (static) (*P. duorarum*)	94	>10	slightly toxic	40228401 Mayer, 1986	supplemental

These estuarine/marine invertebrate acute toxicity studies with acephate classify acephate as moderately toxic (LC_{50} = >1-10 mg/L) to practically non-toxic (LC_{50} >100 mg/L) to estuarine/marine invertebrate species on an acute exposure basis. A complete list of all the acute estuarine/marine invertebrate toxicity data for acephate is provided above.

The most sensitive acephate estuarine/marine invertebrate study found the 96 hr **LC_{50}** for the pink shrimp (*Penaeus duorarum*) to be **3.8 mg a.i./L** (MRID 40228401, Mayer, 1986). The range of acephate LC_{50} toxicity for estuarine/marine invertebrates in six studies was 3.8 to 150 mg/L. Only one other study used pink shrimp; this study found a non-definitive 96 hr LC_{50} of >10 mg/L (MRID 40228401, Mayer, 1986). Two other shrimp studies used mysid (*Americamysis bahia*) and brown shrimp (*Penaeus aztecus*) and found LC_{50}s of 7.3 mg/L (96 hr) and 22.9 mg/L (48 hr), respectively (MRID 40228401, Mayer, 1986; MRID 00014711, Sleight, 1970). Two studies on the eastern oyster larvae (*Crassostrea virginica*) found LC_{50}s of 5.41 mg/L (48 hr) and 150 mg/L (96 hr) (MRID 40228401, Mayer, 1986; MRID 00014713, Sleight, 1970).

3.3.2 Studies for the degradate methamidophos.

Table D.57. Estuarine/Marine Invertebrate Acute Toxicity for Methamidophos					
Species	% ai	96-hour LC_{50} (mg/L)	Toxicity Category	MRID No. Author/Year	Study Classification
Oyster – shell deposition (*C. virginica*)	72.9	36 (95% CI 30-47)	slightly toxic	40088601, 40074701 Surprenant, 1987	supplemental[1]
Mysid shrimp *(A. bahia)*	**technical**	**1.054 (95% CI 0.756 – infinity)[2]**	**moderately toxic**	**00144430 Larkin, 1983**	**acceptable**
White shrimp *(Litopenaeus vannamei)*	600 g/L formulation	1.46 (corrected for %ai)	moderately toxic	ECOTOX #88461 Garcia-de la Parra et al. 2006	open literature study

[1] Due to the lack of raw data.
[2] Of the 5 test concentrations, only the highest concentration showed any mortality (70%).

The estuarine/marine invertebrate acute toxicity studies with methamidophos classify methamidophos as slightly toxic (LC_{50} = >10-100 mg/L) to moderately toxic (LC_{50} = >1-10 mg/L) to estuarine/marine invertebrate species on an acute exposure basis.

The most sensitive methamidophos estuarine/marine invertebrate study found the 96 hr **LC_{50}** for the mysid shrimp (*A. bahia)* to be **1.054 mg a.i./L** (MRID 144430, Larkin, 1983). The range of methamidophos LC_{50} toxicity for estuarine/marine invertebrates in three studies was 1.054 to 36 mg/L. One other study used the white shrimp (*Litopenaeus vannamei*); this study found a 96 hr LC_{50} of 1.46 mg/L (ECOTOX #88461, Garcia-de la Parra et al. 2006). An oyster shell deposition study found a 96 hr LC_{50} of 36 mg/L (MRIDs 40088601, 40074701, Surprenant, 1987).

The methamidophos RED (1998) includes a blue shrimp (*Penaeus stylirostris*) study classified as supplemental in the above table.[16] This study was not cited here because it did not meet EPA's validity criteria and has been downgraded to invalid. The study was a static renewal study in which the organisms were handled every 24 hours. During the handling process, mortality occurred. The mortality in the controls ranged from 60% to 80%. EPA's criteria only allows up to 10% mortality in the controls. Furthermore, EPA recognizes that in the FWS Recovery Plan for the California Red-Legged Frog, [17] this study was cited as evidence that methamidophos is very highly toxic to aquatic invertebrates.

3.4 Estuarine and Marine Invertebrate, Chronic

3.4.1 Studies using the parent chemical, acephate

Table D.58. Estuarine/Marine Invertebrate Life-Cycle Toxicity for Acephate					
Species	% ai	21-day NOAEC/LOAEC (mg ai/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Mysid shrimp *(A. bahia)*	**technical grade**	**0.58/1.4**	**mortality[1]**	**00066341, 40228401 Mayer, 1986**	**supplemental**

[1] Survival of the progeny of the acephate-exposed mysids was not affected.

One chronic estuarine/marine invertebrate study was available for acephate. This life cycle study on the mysid shrimp (*A. bahia*) found a 21-day **NOAEC** of **0.58 mg a.i./L** and a LOAEC of 1.4 mg a.i./L (MIRDs 66341, 40228401, Mayer, 1986). The NOAEC and LOAEC were derived from the most sensitive endpoint, adult mortality; the survival of progeny was not affected.

3.4.2 Studies using the degradate, methamidophos

Table D.59. Estuarine/Marine Invertebrate Life Cycle Toxicity for Methamidophos					
Species	% ai	21-day NOAEC/LOAEC (mg ai/L)	Endpoints Affected	MRID No. Author/Year	Study Classification
Mysid shrimp *(A. bahia)*	**78.5**	**0.174/0.360**	**dry weight[1]**	**46646001 Blankinship et. al., 2005**	**acceptable**

[1] Other endpoint NOAEC/LOAEC: offspring per reproductive day 0.360/0.669; larvae survival 0.669/1.35; length 0.360/0.669

One chronic estuarine/marine invertebrate study was available with methamidophos. This life cycle study on the mysid shrimp (*A. bahia*) found a 21-day **NOAEC** of **0.174 mg a.i./L** and a LOAEC of 0.360 mg a.i./L (MRID

[16] Juarez, L.M., J. Sanchez, 1989. Toxicity of the Organophosphorous Insecticide Methamidophos (O,S-Dimethyl Phosphoramidothioate) to Larvae of the Freshwater Prawn, *Macrobachium rosenbergii* (DeMan) and the Blue Shrimp, *Penaeus stylirostris* Stimpson. Bull. Environ. Contam. Toxicol. (1989) 43:302-309.
[17] U.S. Fish and Wildlife Service. 2002. Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*). U.S. Fish and Wildlife Service, Portland, OR. viii + 173 pp.

46646001, Blankinship *et al.*, 2005). The NOAEC and LOAEC were derived from the most sensitive endpoint, dry weight of the adult mysids. Other endpoints in this study were offspring per reproductive day (NOAEC 0.360 mg a.i./L, LOAEC 0.669 mg a.i./L), larvae survival (NOAEC 0.669 mg a.i./L, LOAEC 1.35 mg a.i./L), and length of adult mysids (NOAEC 0.360 mg a.i./L, LOAEC 0.669 mg a.i./L).

4 Toxicity to Terrestrial Animals

4.1 Birds, Acute and Sub-acute

As specified in the Overview Document, the Agency uses birds as a surrogate for reptiles and terrestrial-phase amphibians when toxicity data for each specific taxon were not available (USEPA, 2004). The available open literature reviewed had no information on acephate toxicity to reptiles or terrestrial-phase amphibians. Avian toxicity endpoints from open literature were generally less sensitive than those from the registrant submitted avian studies.

4.1.1 Studies using the parent chemical, acephate

Table D.60. Avian Acute Oral Toxicity for Acephate

Species	% ai	LD_{50} (mg ai/kg-bw)	Toxicity Category	MRID No. Author/Year	Study Classification
Mallard duck (*Anas platyrhynchos*)	89	350	moderately toxic	00014700 Mastalski, 1970	acceptable
Mallard duck (*A. platyrhynchos*)	93.2	234	moderately toxic	00160000 Hudson, 1984	acceptable
Mallard duck (*A. platyrhynchos*)	89	350	moderately toxic	00015962 Hudson, 1972	acceptable
Bobwhite quail (*Colinus virginianus*)	15[1]	109[2]	moderately toxic	43939301 Campbell, 1992	acceptable
Pheasant (*Phasianus colchicus*)	89	140	moderately toxic	00014701 Mastalski, 1970	acceptable
Dark eyed junco (*Junco hyemalis*)	75	106[3]	moderately toxic	00093911 Zinkl, 1981	supplemental
Zebra Finch (*Taeniopygia guttata*)	**98.8**	**86.9 (95% CI: 69.6 to 108)[4] Slope: 7.3 (3.4-11.1)**	**moderately toxic**	**48924601 Dias, 2012**	**acceptable**

[1] This was a granular formulation. Slope = 5.4; Formulation LD_{50} = 734 mg a.i./kg (86-139 mg/kg formulation)
[2] This endpoint was used in the terrestrial exposure modeling.
[3] The birds initially refused to ingest larvae that contained 16 µg acephate/larvae; however, the birds were willing to consume larvae containing five µg acephate. The study found that acephate given by gavage without larvae produced more inhibition than the larvae-fed birds. The study also concludes that the higher the dose, the more ChE inhibition was found in the birds. Increased time of exposure may prolong the time for recovery from ChE inhibition. Feeding the birds larvae containing acephate may decrease the activity of the acephate when compared to the gavage. The birds fed for five days recovered in 12 to 22 days.
[4] Signs of toxicity were observed in the ≥64 mg/kg treatment groups and included underactivity, uncoordination, recumbency, salivation, rapid breathing, head shaking, ruffled feathers, and/or body tremors. For the 38 mg/kg group, the signs of toxicity included uncoordinated and underactive behavior within the first 20 hours after dosing. There were no apparent treatment-related effects on body weight or body weight change at any interval for males or females at any treatment group compared to the control. Food consumption was slightly reduced for the surviving female bird in the 107 mg/kg group.

Table D.61. Avian Subacute Dietary Toxicity for Acephate					
Species	% ai	5-Day LC_{50} (mg ai/kg)	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(C. virginianus)*	95.3	1280	slightly toxic	00015956 Fletcher, 1976	acceptable
Mallard duck (*A. platyrhynchos*)	95.3	>5000	practically non-toxic	00015957 Fletcher, 1976	acceptable
Dark eyed junco (*J. hyemalis*)	75	1485	slightly toxic	00093911 Zinkl, 1981	supplemental
Japanese Quail *(Coturnix japonica)*	**15.6**	**718**	**moderately toxic**	**40910905 Hill and Camardese, 1986**	**supplemental**
Japanese Quail *(C. japonica)*	98	3275	slightly toxic	40910905 Hill and Camardese, 1986	supplemental
Other routes of exposure: Inhalation					
Northern bobwhite quail *(C. virginianus)*	formulation	3/6 dead within 100 minutes[2]	NA	Berteau and Chiles, 1978[1]	ancillary

[1] In this inhalation study, bobwhites were exposed to 2.2 mg/L of acephate for 100 minutes. Citation found in **References** section.

Acephate toxicity has been evaluated in multiple avian species including zebra finch (*Taeniopygia guttata*), mallard duck (*Anas platyrhynchos*), bobwhite quail (*Colinus virginianus*), dark-eyed junco (*Junco hyemalis*), pheasant (*Phasianus colchicus*), and Japanese quail (*Coturnix japonica*). Acute oral LD_{50} values for acephate range from 106 mg a.i./kg-bw to 350 mg a.i./kg-bw. The range of subacute dietary LC_{50} values was 718 to >5000 mg a.i./kg-diet.

The most sensitive **LD_{50}** value suitable for use in RQ calculations was **86.9 mg a.i./kg-bw** (69.6 to 108 mg a.i./kg-bw) for the zebra finch (MRID 48924601). The probit slope was 7.3. This is a more sensitive endpoint than the one formerly used for risk assessments using the mallard of 109 mg a.i./kg-bw (MRID 43939301, Campbell, 1992). That study was conducted with a granular formulation (15% a.i.). The probit slope was 5.4. The formulation LD_{50} = 734 mg a.i./kg (86-139 mg/kg formulation). Another study had a similar acute oral LD_{50} value – 106 mg a.i./kg-bw for the dark eyed junco (MRID 93911, Zinkl, 1981). However, this study had significant uncertainty based on study design and therefore this value was not used quantitatively in this assessment. There were 5 dose groups with a geometric progression of 1.4x (EPA recommends 2x). Only 4 birds were tested in each dose group (EPA recommends 10). The 106 mg a.i./kg-bw dose group mortality was 2/4 (50%). No confidence interval and no probit slope were calculated. This study compared the LD_{50} value of birds fed larvae laced with acephate with birds that were given acephate by gavage. The birds initially refused to ingest larvae that contained 16 µg acephate; however, the birds were willing to consume larvae containing 5 µg acephate.

The most sensitive **LC_{50}** value was **718 mg a.i./kg-diet** for the Japanese quail (*C. japonica*) (MRID 40910905, Hill & Camardese, 1986). This study was classified as supplemental due to a lack of raw data and study-specific information. The endpoint was reported as part of a larger report on avian toxicity of multiple chemicals.

Acephate was categorized as moderately toxic to avian species on an acute oral basis and practically non-toxic to moderately toxic to avian species on a subacute-dietary basis. A complete list of all the acute avian toxicity data for acephate is provided above.

4.1.2 Studies using the degradate, methamidophos

Table D.62. Avian Acute Oral Toxicity for Methamidophos					
Species	% ai	LD_{50} (mg/kg-bw) (confidence interval)	Toxicity Category (slope)	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(C. virginianus)*	75	8 (6.2 – 10.3)	very highly toxic (7.36)	00014094, 00109717 Fletcher, 1971	supplemental[1]
Northern bobwhite quail *(C. virginianus)*	75	10.1 (7.9 – 13.1) (m) 11.0 (8.5 – 14.1) (f)	highly toxic	00041313 Nelson et al, 1979	acceptable
Mallard duck *(A. platyrhynchos)*	75	8.48 (6.73 – 10.7)	very highly toxic	0016000 Hudson et al 1984	acceptable
Mallard duck *(A. platyrhynchos)*	75	29.5 (27.3 – 31.9)	highly toxic	00014095, 00109718 Fletcher, 1971	supplemental[2]
Dark eyed junco (*J. hyemalis)*	73	8	very highly toxic	ECOTOX #39519 00093914 Zinkl et al, 1979	supplemental[3]
Common grackle (*Quiscalur quiscula*)	**55**	**6.7 ai (4.1 – 10.9)**	**very highly toxic**	**00144428 Lamb, 1972**	**supplemental[4]**
Starling (Sturnidae)	75	10 (5.6 – 17.8)	very highly toxic	00146286 Schafer, 1984	supplemental[5]
Redwing blackbird (*Agelaius phoeniceus)*	75	1.78	very highly toxic	00146286 Schafer, 1984	supplemental[5]
Zebra Finch (*T. guttata*)	74.26	10.7 (95% CI: 7.64 to 14.4)[6] Slope: 6.5 (1.8 to 11.2)	highly toxic	48924602 Ross, 2012	supplemental[7]

[1] Due to age of birds (older) and insufficient study design information. Death occurred 8 – 22 hrs after dosing.
[2] Due to poor dose response that precludes development of the best estimate of LD50. Death occurred 1 hr after dose.
[3] Due to post dose observations were only 6 hrs instead of 14 days.
[4] Due to five birds dosed per treatment level (including control) and insufficient environmental information. EPA guidelines call for ten birds per treatment level. All mortalities occurred within 24 hrs.
[5] This test was an "up/down" test by FWS. Only two doses were used (3.16 and 1.0 mg/kg) with resulting mortality being 2 out of 2 birds tested and 0 out of 2 birds tested, respectively.
[6] Signs of toxicity were observed in the 5.4, 9.0 and 15.0 mg/kg treatment groups and included underactivity, closed eyes, recumbency, body tremors, salivation, and/or rapid breathing/panting. In the 1.9 and 3.2 mg/kg groups, the transient signs of toxicity were resolved by 4 hours after dosing and included body tremors, underactivity, ruffled feathers, and wiping beaks on cage perches. One control bird was observed with its beak held open one minute after dosing. Regurgitation (emesis) was observed for one vehicle control bird, one male 9.0 mg/kg bird and three 15.0 mg/kg birds (1 male and 2 females). There were no apparent treatment-related effects on body weight, body weight change, or food consumption in any treatment group.
[7] This study was classified as supplemental due to observed regurgitation, which increased uncertainty but may be used quantitatively in risk calculation.

Table D.63. Avian Subacute Dietary and Dermal Toxicity for Methamidophos					
Species	% ai	5-Day LC_{50} (mg/kg) (confidence interval)	Toxicity Category (slope)	MRID No. Author/Year	Study Classification
Dietary Exposure					
Northern bobwhite quail *(C. virginianus)*	**74**	**42 (34 – 52)[1]**	**very highly toxic (3.4)**	**00093904 Beavers & Fink,1979**	**acceptable**
Northern bobwhite quail *(C. virginianus)*	75	57.5 (40 – 82)[2]	highly toxic	00014064 Jackson, 1968	supplemental[3]
Northern bobwhite quail *(C. virginianus)*	75	59 (48-72)	highly toxic (6.445)	44484404 Thompson-Cowley, 1981	supplemental
Mallard duck *(A. platyrhynchos)*	75	1302 (906 – 1872)[1]	slightly toxic	00041658, Nelson et al 1979	acceptable
Mallard duck *(A. platyrhynchos)*	75	847.7 (600 – 1198)[4]	moderately toxic (4.27)	00130823, 00014304 00145655, Lamb & Bunke 1977	supplemental[5]
Mallard duck *(A. platyrhynchos)*	70	1650 (1138 – 2392)	slightly toxic	44484403 Shapiro, 1981	supplemental
Japanese Quail	73	92	highly toxic	Smith, 1987[6]	supplemental
Dermal Exposure					
Starling (Sturnidae)	75	17.8	NA	00146286 Schafer, 1984	supplemental
Redwing blackbird *(A. phoeniceus)*	75	31.6	NA	00146286 Schafer, 1984	supplemental

[1] Note that birds were too sick to eat.
[2] Observed repellency at 826 mg/kg. Death occurred at 2 to 7 days after exposure.
[3] Due to birds being 12 weeks of age instead of 10 to 17 days old.
[4] Death occurred 1 to 6 days after exposure. There was 60% mortality at 1000 mg/kg. Birds recover 5 to 8 days post treatment.
[5] Due to 60 gm average weight difference of birds in control to birds in treatment groups at day 0, 4 concentrations used instead of 6 concentrations, and incomplete design.
[6] Citation found in **References** section.

Methamidophos was categorized as highly to very highly toxic to avian species on an acute oral basis and slightly to very highly toxic to avian species on a subacute dietary basis. Methamidophos toxicity has been evaluated in multiple avian species including mallard duck (*A. platyrhynchos*), bobwhite quail (*C. virginianus*), Japanese quail (*C. japonica*), dark eyed junco (*J. hyemalis*), common grackle (*Quiscalur quiscula*), starling (Sturnidae), and redwing blackbird (*Agelaius phoeniceus*). Acute oral LD_{50} values for methamidophos range from 1.78 to 29.5 mg a.i./kg-bw. The range of subacute dietary LC_{50} values was 42 to 1650 mg a.i./kg-diet.

The most sensitive acute oral LD_{50} value was 1.78 mg a.i./kg-bw for the redwing blackbird (MRID 146286, Schafer, 1984). This study was an "up/down" test, which did not comply with current EPA guidelines. Only two doses were used (3.16 and 1.0 mg a.i./kg) with resulting mortality 2/2 birds tested and 0/2 birds tested, respectively. The next lowest **LD_{50}** value was **6.7 mg a.i./kg-bw** (4.1-10.9 mg a.i./kg-bw) for the common grackle (MRID 144428, Lamb, 1972). This study was classified as supplemental due to the use of only 5 birds per treatment level, including the control (EPA recommends 10). However, the study was considered scientifically sound and the endpoint useable. The most sensitive dietary **LC_{50}** value was **42 mg a.i./kg-diet** for the bobwhite quail (MRID 00093904 (Beavers & Fink, 1979).

4.2 Birds, Chronic

4.2.1 Studies using the parent chemical, acephate

Table D.64. Avian Reproductive Toxicity for Acephate					
Species	% ai	NOAEC/LOAEC (mg/kg-diet)	LOAEC Endpoints	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(C. virginianus)*	technical grade	20/80	Reduced body weight, number of eggs laid, eggs set, viable embryos, live 3-week embryos, normal hatchlings, and 14-day old survivors	00029692 Beavers, 1979	acceptable
Mallard duck ***(A. platyrhynchos)***	**technical grade**	**5/20**	**Reduced number viable embryos, live 3-week embryos**	**00029691 Beavers, 1979**	**acceptable**

The most sensitive avian reproduction study with acephate found impacts to embryo survival when mallard duck parents were fed between 5 and 20 mg/kg technical grade acephate. The effects seen at 20 mg a.i./kg-diet included a reduced number of viable embryos and live 3 week embryos. The **NOAEC** for the mallard was **5 mg a.i./kg-diet** and the LOAEC 20 mg a.i./kg-diet (MRID 29691, Beavers, 1979).

Reproductive effects seen in a study on northern bobwhite quail at 80 mg/kg-diet acephate included reduced body weight, number of eggs laid, eggs set, viable embryos, number of embryos alive at 3 weeks, number of normal hatchlings, and 14-day old survivors. The NOAEC was 20 mg/kg-diet for the bobwhite quail and the LOAEC was 80 mg/kg-diet (MRID 29692, Beavers, 1979).

4.2.2 Studies using the degradate methamidophos

Table D.65. Avian Reproductive Toxicity for Methamidophos					
Species	% ai	NOAEC/LOAEC (mg/kg-diet)	LOAEC Endpoints	MRID No. Author/Year	Study Classification
Northern bobwhite quail ***(C. virginianus)***	**73**	**3/5**	**Eggshell thickness, embryo viability, embryo development, hatchability, survivability of hatchlings**	**00014114 Beavers & Fink, 1978**	**acceptable**
Mallard duck *(A. platyrhynchos)*	73	>15	No effect	00014113 Fink, 1977	supplemental
Northern bobwhite quail *(C. virginianus)*	73	5/7.8	Egg production	ECOTOX #40022 Stromberg, et. al., 1986	open literature study

Avian reproduction studies with methamidophos found impacts to embryo and chick survival when bobwhite quail parents were fed between 3 and 5 mg/kg-diet methamidophos. The effects seen at 5 mg a.i./kg-diet included reduced eggshell thickness, embryo viability, embryo development, hatchability, and survival of hatchlings. The **NOAEL** for the bobwhite quail was **3 mg a.i./kg-diet** (MRID 14114, Beavers & Fink, 1978).

One other bobwhite quail study found a NOAEC of 5 mg/kg-diet and a LOAEC of 7.8 mg/kg-diet based on egg production (MRID 14113, Fink, 1977). No reproductive effects were observed in a study using mallard duck and methamidophos concentrations up to 15 mg/kg-diet (ECOTOX 40022, Stromberg et al., 1986).

4.2.3 Birds: Sublethal Effects and Additional Open Literature Information

Studies of sublethal effects of acephate exposure to avian species focus largely on cholinesterase (ChE) inhibition and behaviors surrounding this mode of action. Findings of these studies, including laboratory and field studies, are summarized below. Five field studies described below report ChE inhibition in birds following applications rates of 0.5-2.0 lb a.i./A, within the range of labeled acephate application rates. A dietary study demonstrates ChE inhibition as low as 0.5 mg a.i./kg-diet and irreversibly so above 16 mg a.i./kg-diet This study showed toxicity below the reproductive NOAEC of 5 mg a.i./kg-diet and far below the acephate dietary LC_{50} of 718 mg a.i./kg-diet.

The acute oral dark eyed junco study found that the higher the dose, the greater the ChE inhibition in birds (MRID 93911, Zinkl, 1981). Increased exposure time also prolonged the recovery time for ChE inhibition. Feeding the birds larvae containing acephate decreased the activity of the acephate when compared to the gavage method. The birds fed for five days recovered in 12 to 22 days.

Vyas (ECOTOX 40313, 1995) reported that acephate affected adult migratory white-throated sparrows (*Zonotrichia albicollis*). Adult birds exposed to 256 mg/kg acephate a.i. were not able to establish a preferred migratory orientation and exhibited random activity. All juvenile treatment groups displayed a seasonally correct southward migratory orientation. The author hypothesized that acephate may have produced aberrant migratory behavior by affecting the memory of the adult's migratory route and wintering ground. The "experiment reveals that an environmentally relevant concentration" (similar to 0.5 lb a.i./A application) of an OP such as acephate "can alter migratory orientation, but its effect was markedly different between adult and juvenile sparrows. Results suggest that the survival of free-flying adult passerine migrants may be compromised following organophosphate pesticide exposure."

Another study by Vyas (ECOTOX 40343, 1996) reported the effects of a 14-day dietary exposure of acephate on ChE activity in three regions; basal ganglia, hippocampus, and hypothamulus were examined in the brain of the white-throated sparrow, *Z. albicollis*. All three regions experienced depressed ChE activity between 0.5-2 mg a.i./kg-diet. The regions exhibited ChE recovery at 2-16 mg a.i./kg-diet; however, ChE activity dropped and showed no recovery at higher dietary levels (>16 mg a.i./kg-diet). Each region of the brain is responsible for different survival areas such as a foraging and escaping predators, memory and spatial orientation, food and water intake, reproduction and several others. Data indicated that the recovery was determined by the magnitude of ChE depression, not the duration. In general, as acephate concentration increased, depression in ChE activity among brain regions increased and differences of ChE activity among the three brain regions decreased. The pattern of ChE depression in different regions of the brain following low level exposure may be a critical factor in the survival of the bird. The authors hypothesized that adverse effects to birds in the field may occur at pesticide exposure levels considered negligible.

Zinkl (1978) studied several large acreages of forest that were sprayed with acephate at 0.5, 1.0 or 2.0 lb. a.i./A application rates. There was no brain ChE inhibition on day zero after application. Birds collected from the 2 lb a.i./A plots from day one through six post-spray showed ChE inhibition. Brain ChE inhibition was shown in birds 33 days after treatment but not 89 days after treatment. Birds had more inhibition of ChE in summer application when compared to the fall application in the 1 lb a.i./A plots (30-50% and 25-40% depression, respectively). The greatest ChE inhibition occurred in dark-eyed juncos (65%) collected 15 days after treatment. In the 2 lb a.i./A plots, dark-eyed juncos and golden-crowned kinglets had 54% ChE inhibition. Of the 14 species collected, only pine siskins *(Siinus pinus)* did not show any ChE inhibition. Symptoms of organophosate poisoning were observed such as profuse salivation of a warbling vireo, difficulty maintaining perching position of an American robin, and visible tremors in a mountain chickadee. All of these observations were made in the 1 lb a.i./A plots. The authors concluded that since marked ChE inhibition did not occur on day zero, but was evident up to 33 days after application, there was either an accumulative effect that was detected later or acephate was converted to a more potent ChE inhibitor such as methamidophos. Spraying the forest with 0.5, 1.0, or 2.0 lb. a.i./A caused marked and widespread, and prolonged ChE depression in passerine birds.

Two additional studies by Zinkl (ECOTOX 39518, 1980, MRID 40329701, 1979) looked at results of acephate sprayed in a forest at 0.5 lb a.i./A. Eleven species of birds had ChE inhibition ranging from 20 to 40%. The maximum depression of ChE found in chipping sparrows was 57% at day six. Western tanagers were found to have significant inhibition up to 26 days after application. Brain residue analysis of a western tanager collected on day three contained 0.318 mg/kg-diet of acephate and 0.055 mg/kg-diet of methamidophos.

In a study by Bart (MRIDs 163173, 5014922, 1979), acephate was applied in this study in the month of June at 0.55 kg/ha (0.5 lb a.i./A) on two 200 hectare plots. Authors measured the presence of the red-eyed vireos by the number of their particular songs. Significant ($P<0.05$) decline in number of red-eyed vireos was observed. The decline was concentrated in the interior of the treated plots rather than spread throughout. The study did not determine whether the decline was due to direct or indirect effects on vireos.

In a lab study, Rudolph (MRID 141694, 1984) dosed kestrels with 50 mg/kg of 75% acephate formulation. Serum ChE was 37% inhibited and returned to predosed levels eight days later. The birds were then dosed again and serum ChE activity was inhibited 42% while brain ChE was inhibited 26%. Prey-catching activity was not altered.

A study in the Oregon Wallowa-Whitman National Forest by Richmond (MRID 40644802, 1979) used applications of 1.12 (1.0 lb a.i./A) and 2.24 (2.0 lb a.i./A) kg/ha on forest plots. Extensive inhibition of brain ChE activity (30-50%) was observed for up to 33 days for 11 of the 12 species of birds collected. The highest frequency of ChE inhibition was observed on day two post-spray. Some birds on the plots treated with 1.12 kg/ha had 65% ChE inhibition. At both plots, birds were found with coordination problems, salivating profusely, and unable to fly. These behaviors were observed up to 20 days after application in the 2.24 kg/ha plot. It was also observed that breeding pairs for the warbling vireo and yellow-rumpled warbler decreased. The authors concluded that application of acephate at rates of 1.12 and 2.24 kg/ha can cause sickness and death to forest birds.

A study by McEwen (MRID 93909, 1981) in WY, UT, and AZ rangeland found that birds collected in 1979 and 1980 up to 24 days after acephate application at 0.0938 lb ai/A had reduced ChE activity. Reduction of 20% or more is indicative of brain exposure to a ChE inhibitor. Of the birds collected in AZ, 24.5% had reduced ChE activity >20%. The birds with the greatest ChE inhibition were the last ones collected (21-24 days post treatment). In 1981, horned larks and lark buntings were collected in WY on a 12,000 acre plot that was treated with acephate at the same rate of 0.0938 lb ai/A. More than 20% ChE inhibition was found in 19% of the horned larks and 25% of the lark buntings.

Foudoulakis,M., C. Balaskas, A. Csato, C. Szentes, and G. Arapis (2013; ECOTOX No. 165252) found that the Japanese quail (*C. japonica*) methamidophos NOAEC based on mortality was 1 mg/kg-bw (LOAEC 2.2 mg/kg-bw) based on oral dosing study (LD_{50} was between 2.2-11.2 mg/kg-bw) but concentrations were not measured. The study was considered supplemental information from the open literature endpoint used to support the grackle endpoint of 6.7 mg/kg-bw.

4.3 Mammals, Acute and Chronic

A summary of acute and chronic mammalian data, including data published in the open literature, is provided below. A more complete analysis of toxicity data to mammals is available in the Health Effects Division (HED) chapter prepared in support of the re-registration eligibility decision (RED) finalized in 2006 and is also found as **Appendix J** of the 2011 San Francisco Bay assessment http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/2011/acephate2/analysis.pdf.

4.3.1 Studies using the parent chemical, acephate

Table D.66. Mammalian Toxicity for Acephate

Species	% ai	Test Type	Toxicity Value	Affected Endpoints	MRID No. Author/Year
Rat *(Rattus norvegicus)*	23.7	oral acute	LD_{50}= 970 mg/kg (f)	mortality	237487
Rat *(R. norvegicus)*	85	oral acute	LD_{50}= 1490 mg/kg (m) 739 mg/kg (f)	mortality	236863, 236864
Rat *(R. norvegicus)*	98	oral acute	LD_{50}= 945 mg/kg (m) 866 mg/kg (f)	mortality	00014675

Table D.66. Mammalian Toxicity for Acephate					
Species	% ai	Test Type	Toxicity Value	Affected Endpoints	MRID No. Author/Year
White-footed mouse *(Peromyscus leucopus noveboracensis)*	98	oral acute	LD50= 380 mg/kg	mortality	ECOTOX #38448 Rattner and Hoffman, 1984
Meadow vole *(Microtus pennsylvanicus)*	**98**	**oral acute**	**LD_{50}= 321 mg ai/kg**	**mortality**	**ECOTOX #38448 Rattner and Hoffman, 1984**
Mouse *(Mus musculus)*	70%	oral acute	LD_{50}= 720 mg ai/kg	mortality	ECOTOX #39704 Clark and Rattner, 1987
Mouse *(M. musculus)*	98	oral acute	LD_{50}= 351 mg/kg	mortality	ECOTOX #38448 Rattner and Hoffman, 1984
Brown bat *(Myotis lucifugus)*	70%	oral acute	LD_{50}>1500 mg ai/kg ED_{50}= 687 mg ai/kg	mortality	ECOTOX #39704 Clark and Rattner, 1987
Charles River rat *(R. norvegicus)*	98.7	3-generation reproductive	NOAEC = 50 mg/kg-diet LOAEC = 500 mg/kg-diet	parental and pup weight, food consumption, litter size, mating performance and viability	40323401 40605701

Acephate is categorized as moderately toxic to small mammals on an acute oral basis. Mammalian acephate toxicity studies indicate that the toxicity ranges from slightly to moderately toxic to small mammals on an acute oral basis. Acephate oral toxicity to small mammals was tested on multiple species including the laboratory rat (Rattus norvegicus), white-footed mouse (Peromyscus leucopus noveboracensis), laboratory mouse (Mus musculus), meadow vole (Microtus pennsylvanicus), and brown bat (Myotis lucifugus). LD_{50} values ranged from 321 mg/kg-bw to >1500 mg/kg-bw over eight studies. The most sensitive acute oral LD_{50} was 321 mg/kg-bw for the meadow vole (ECOTOX 38448, Rattner and Hoffman, 1984). LD_{50}s reported for mice were similar to the meadow vole at 351 and 380 mg/kg (one study reported 720 mg/kg) while toxicity values reported for rats were higher at 739, 866, and 970 mg/kg (ECOTOX 38448, Rattner and Hoffman, 1984; ECOTOX 39704, Clark and Rattner, 1987; MRID 237487; MRIDs 236863, 236864; MRID 00014675).

Laboratory data indicate that acephate and its degradate, methamidophos, may pose chronic risk to mammals by affecting reproductive capacity. A 3-generation study on Charles River rats (R. norvegicus) found that when female rats were fed acephate at 500 mg/kg-diet, the LOAEC, they exhibited significant adverse effects on parental and pup body weight, food consumption, litter size, mating performance, and viability. The NOAEC was 50 mg/kg-diet acephate, the level at which rats showed no effects (MRIDs 40323401, 40605701).

4.3.2 Studies using the degradate methamidophos

Table D.67. Mammalian Toxicity for Methamidophos					
Species	% ai	Test Type	Toxicity Value	Affected Endpoints	MRID No. Author/Year
Laboratory rat *(R. norvegicus)*	**95**	**acute oral**	**LD_{50}= 15.6 mg ai/kg (m) LD_{50}= 13.0 mg ai/kg (f)[1]**	**mortality**	**00014044 Cavalli & Hallesy,1968**
Laboratory mouse *(M. musculus)*	95	acute oral	LD_{50}= 16.2 mg/kg (f)	mortality	00014047 Cavalli & Hallesy,1968
Laboratory mouse *(M. musculus)*	75	acute oral	LD_{50}= 18 mg/kg (f)	mortality	00014048
Laboratory rat *(R. norvegicus)*	**70.5**	**2-generation reproductive**	**NOAEC=10 mg/kg-diet[2] LOAEC= 33 mg/kg-diet[2]**	**Decrease in number of births, pup viability and body weight**	**00148455 41234301**

[1] Data was not reported for the two lowest test concentrations for the female rats. The male rat LD_{50} value was used in the risk assessment.
[2] The study indicates that 10 mg/kg-diet = 0.5 mg/kg/day and 33 mg/kg-diet = 1.65 mg/kg/day; 33 mg/kg-diet was the highest dose tested.

Methamidophos is categorized as highly toxic to small mammals on an acute oral basis. Methamidophos oral toxicity was tested on the laboratory rat (*R. norvegicus*) and laboratory mouse (*M. musculus*). LD_{50} values ranged from 13.0 mg/kg-bw to 18 mg/kg-bw. The most sensitive acute oral LD_{50} was 13.0 mg/kg-bw for the female laboratory rat (MRID 14044, Cavalli and Hallesy, 1968). However, the data in this study for the female rats indicates missing data for the two lowest test concentrations. Therefore, the **LD_{50}** value used for risk assessment was **15.6 mg/kg-bw** for male rats, which had a complete data set, from the same study (MRID 14044, Cavalli and Hallesy, 1968).

A 2-generation study on laboratory rats showed that 33 mg/kg-diet methamidophos, the LOAEC, in food adversely affected the survival of embryos and pups. This equated to 1.65 mg/kg-bw/day. The **NOAEC** was **10 mg/kg-diet** methamidophos, equivalent to 0.5 mg/kg-bw/day, the level at which rats showed no effects (MIRDs 148455, 41234301).

4.3.3 Mammals: Sublethal Effects and Additional Open Literature Information

Studies from the open literature of sublethal effects to mammals as a result of acephate exposure are summarized below. Two field studies described below report ChE inhibition in small mammals following applications rates of 0.5-1.0 lb a.i./A, within the range of labeled acephate application rates. Reproductive toxicity studies reported effects on male mice at 14 mg/kg/day and on female mice at 28 mg/kg/day, lower than the guideline study value of 50 mg/kg/day for acephate.

Zinkl (MRID 40329701, ECOTOX 39518, 1980) found a marked inhibition of brain ChE activity in squirrels but no mortality after aerial acephate treatment of forests at 0.57 kg/ha (0.51 lb/A).

McEwen (MRID 93909, 1981) collected small samples of deer mice in 1980 and 1981 in WY up to 12-14 days after an acephate application of 0.0938 lb ai/A. They were found to have ChE inhibition from 12.7% to 14.6%. The potential populations effects of these levels of inhibition were not well understood.

A study by Stehn (ECOTOX 35459, 1976) reported increased ingestion of arthropods by insectivorous mammals following acephate application. This signified a direct pathway for substantial exposure to acephate due to consumption of dead and dying insects.

Farag (ECOTOX 87471, 2000) studied the reproductive toxicity of acephate to male mice. Adult male mice were treated by gavage with acephate at doses of 0, 7, 14, and 28 mg/kg/day for 4 weeks before mating with untreated females. Signs of cholinergic effects were observed in the 28 mg/kg/day group. Brain and skeletal muscle AchE activity was inhibited only in this group. Acephate treatment was associated with a decreased number of implantations and live fetuses, and an increased number of early resorptions at 28 mg/kg/day. The percent morphologically normal spermatozoa were unaffected in all dose groups; however, sperm motility and count were decreased in the 14 and 28 mg/kg/day groups compared to the control. Histological examination of brain did not reveal any abnormalities. Dose related histological changes, including degeneration of muscle fibers, were observed in the muscles of male mice treated with any of the doses of acephate. The study demonstrated adverse effects of male acephate exposure on pregnancy outcome with effects on sperm parameters at 14 and 28 mg/kg/day.

A second study by Farag (ECOTOX 87472, 2000) evaluated acephate for its potential to produce developmental toxicity in mice after oral administration to females. Pregnant mice were given sublethal doses of 0, 7, 14, and 28 mg/kg/day acephate by gavage on gestation days 6 through 15. Maternal effects in the 28 mg/kg/day dose group included cholinergic signs, decreased body weight at 15 and 18 days of gestation, and decreased absolute and relative brain weight. Placental weight was also decreased and liver weight was increased in the high dose group. Absolute and relative brain weight was decreased in the 14 mg/kg/day group. No maternal effects were apparent in the 7 mg/kg/day dose group. Maternal exposure to acephate during organogenesis significantly affected the number of implantations, number of live fetuses, number of early resorptions, mean fetal weight, and the incidence of external and skeletal malformations in the 28 mg/kg/day dose group. No visceral malformations were observed. Acephate showed maternal and developmental toxicity at 28 mg/kg/day.

4.4 Terrestrial Invertebrates

A summary of acute terrestrial invertebrate data, including data published in the open literature, is provided below.

4.4.1 Studies using the parent chemical, acephate

Table D.68. Non-target Insect Acute Contact and Oral Toxicity for Acephate

Species	Product	LD_{50}	Toxicity Category	MRID No. Author/Year	Study Classification
Honey bee *(Apis mellifera)*	**orthene**	**1.20 µg a.i./bee**	**highly toxic**	**00014714, 44038201 Atkins, 1971**	**acceptable**
Honey bee *(A. mellifera)*	orthene	<0.25 mg/kg[1]	NA	ECOTOX #79198 Fielder, 1987	supplemental
Honey bee *(A. mellifera)*	orthene	NA[2]	NA	ECOTOX #35475 Stoner et al., 1985	supplemental
Green lacewing[3] *Chrysopa carnea*	orthene	5.57 µg/vial	NA	05004012 Plapp, 1978	supplemental

[1] 74.5% mortality at 0.25 mg/kg acephate in sugar syrup after 14 days.
[2] Acephate fed to worker bees via sugar syrup showed up in the royal jelly for the queen, indicating that acephate was systemic to bees. These concentrations of 1 mg/kg or less were harmless to the worker bees but levels at 0.1 mg/kg showed significant reduction of the surviving brood.
[3] Predator of tobacco budworm.

These insect toxicity studies with acephate classify acephate as highly toxic (LD50 <2 µg/bee) to bees and beneficial insects on an acute contact basis. A honey bee acute contact study indicated that acephate is highly toxic to honey bees on an acute contact basis with an LD50 of 1.20 µg a.i./bee (MRIDs 14714, 44038201, Atkins, 1971). Using an average adult honey bee weight of 0.128 g, this equates to 9.4 µg a.i./g bw. Multiple foliar residue studies showed that acephate caused bee mortality from 0 to 96 hours after foliar application at rates from 0.48 to 1.0 lb a.i./A. These studies were preformed on multiple bee species as well as one species of spider.

EPA also reviewed a study (MRID 5004012, Plapp, 1978) that determined toxicity ratios for acephate. By comparing the sensitivity of a beneficial predator insect to that of the pest tobacco budworm, the study determined the relative toxicity to the beneficial insect versus the pest insect. The ratio was calculated using the LC_{50} values for each species. The ratios were 6.4 and 10.0 for the green lacewing and the parasitic wasp, respectively. The ratios of >1 indicate that acephate is more toxic to these two beneficial predators than to the target organism.

Table D.69. Non-target Insect Acute Toxicity for Acephate Formulations					
Species	% ai	lb ai applied	No. hrs. after initial exposure and % dead after contact[1]	MRID No. Author/Year	Study Classification
Honey bee *(A. mellifera)*	75	1.0	0 hr. = 100 2 hr. = 79 8 hr. = 17	00014715 Sakamoto, 1971	acceptable
Alkali bee (*Nomia melanderi*)	75	1.0	2 hr. = 83 8 hr. = 30	00014715 Sakamoto, 1971	acceptable
Alfalfa leaf cutter bee (*Megachile rotundata*)	75	1.0	2 hr. = 69 8 hr. = 21	00014715 Sakamoto, 1971	acceptable
Bumble bee	75	1.0	2hr. = 43	00014715 Sakamoto, 1971	acceptable
Honey bee *(A. mellifera)*	75	1.0	2 hr. = 79 8 hr. = 16	05000837 Johansen, 1972	acceptable
Alkali bee (*N. melanderi*)	75	1.0	2 hr. = 81 8 hr. = 23	05000837 Johansen, 1972	acceptable
Honey bee *(A. mellifera)*	orthene	0.48	1 hr. = 4.5 24 hr. = 98.5 96 hr. = 5.0	00014714 Atkins, 1971	acceptable
Honey bee *(A. mellifera)*	orthene	0.97	1 hr. = 3.2 24 hr. = 100 96 hr. = 41.7	00014714 Atkins, 1971	acceptable
Spiders	acephate	560 gm/ha (0.5 lb ai/A)	Spiders were found to have high mortality (74% dead) at 20 days post spray.	05020212 Hydron, 1979	supplemental
Honey bee *(A. mellifera)*	63	1.37 Slope = 10.32	highly toxic	00036935 Atkins et al., 1975	acceptable

[1] Foliage was sprayed, collected after varying time periods, and then put with bees.

Table D.70. Target Insect Acute Toxicity for Acephate[1]					
Species	% ai	LC_{50}/LD_{50}	Exposure Type	MRID No. Author/Year	Study Classification
Lepidoptera species					
Cotton bollworm larvae[2] *(Helicoverpa armigera)*	95	5.5 µg/larvae (48 hr)	topical	ECTOX #108057 Gunning et al., 1999	open literature study
Diamondback moth larvae *(Plutella xylostella)*	15	42.1 mg/kg (48 hr)	dipped foliage	ECOTOX #152992 Sonoda & Igaki, 2010	open literature study
Douglas-fir tussock moth larvae *(Hemerocampa pseudotsugata)*	technical grade	76.1 µg/g bw (7 day)[3]	topical	ECOTOX #53649 Robertson & Lyon, 1973	open literature study
Gypsy moth larvae *(Lymantria dispar)*	75	0.960 µg/larvae (24 hr)	topical	ECOTOX #99802 Respicio & Forgash, 1984	open literature study
Mediterranean flour moth larvae *(Anagasta kuehniella)*	99.3	48.27 µg/g (24 hr)	topical	48650403 ECOTOX #153300 Mohamad & Oloffs, 1987	open literature study
Oriental fruit moth larvae *(Grapholita molesta)*	technical grade	227.3 µg/g (2 hr)	spray	ECOTOX #63915 Pree et al., 1998	open literature study
Soybean looper larvae *(Pseudoplusia includes)*	**97**	**20.34 µg/g bw (72 hr)[4]**	**topical**	**48650402 ECOTOX #73702 Ottens et al., 1984**	**open literature study**
Soybean looper larvae *(P. includes)*	97	58.4 µg/g bw (72 hr)[5]	topical	ECOTOX #153446 Martin & Brown, 1984	open literature study
Tobacco budworm larvae *(Heliothis virescens)*	technical grade	74.3 µg/g bw (72 hr)[6]	topical	ECOTOX #152802 Rose & Sparks, 1984	open literature study
Western spruce budworm larvae *(Choristoneura occidentalis)*	>95	40.9 µg/g bw (7 day)[7]	topical	ECOTOX #113233 Robertson & Smith, 1984	open literature study
Western spruce budworm larvae *(C. occidentalis)*	99.3	23.21 µg/g (24 hr)	topical	48650403 ECOTOX #153300 Mohamad & Oloffs, 1987	open literature study
Coleoptera species					
Boll weevil adult *(Anthonomus grandis grandis)*	technical grade	>5700.0 µg/g bw (72 hr)[8]	topical	ECOTOX #152802 Rose & Sparks, 1984	open literature study
Coffee bean weevil adult *(Araecerus fasciculatus)*	99.3	>300 µg/g bw (24 hr)[9]	topical	ECOTOX #107388 Childers & Nigg, 1982	open literature study
Mealybug destroyer adult[10] *(Cryptolaemus montrouzieri)*	75	988 mg/l (48 hr)	sprayed foliage	ECOTOX #69300 Morse & Bellows, 1986	open literature study

bw = body weight
[1] Target insect studies are not typically used in assessments of the risks to non-target species. However, this endangered species assessment includes a Lepidoptera species and a Coleoptera species and studies on insects in these orders were therefore considered here
[2] This study used a pyrethroid resistant strain of *H. armigera* that was organophosphate susceptible.
[3] Average larvae weight was 75 mg. LD_{50} = 5.7 µg/larvae.
[4] Larvae weight range 25-40 mg. Assuming avg weight of 32.5, LD_{50} = 0.66 µg/ larvae.
[5] Average larvae weight was 35 mg. LD_{50} = 2.04 µg/ larvae.
[6] Larvae weight range 30-40 mg. Assuming avg weight of 35, LD_{50} = 2.6 µg/ larvae.
[7] Average larvae weight was 84.3 mg. This equates to LD_{50} = 3.45 µg/larvae.
[8] Larvae weight range 15-20 mg. Assuming avg weight of 17.5, LD_{50} >99.8 µg/ weevil.
[9] Average weight was 6 mg. LD_{50} >1.8 µg/weevil.
[10] A beneficial insect predator of the mealybug.

Using the toxicity categories for honey bees, these insect toxicity studies with acephate classify acephate as moderately (LD_{50} = 2-11 µg/organism) to highly (LD_{50} <2 µg/organism) toxic to Lepidoptera species and at most highly toxic to Coleoptera species on an acute contact basis.

4.4.2 Studies using the degradate, methamidophos

Table D.71. Non-target Insect Acute Contact and Oral Toxicity for Methamidophos					
Species	% ai	LD_{50}	Toxicity Category	MRID No. Author/Year	Study Classification
Honey bee (*A. mellifera*)	**63**	**1.37 µg a.i./bee Slope = 10.32**	**highly toxic**	**00036935 Atkins et al., 1975**	**acceptable**
Honey bee (*A. mellifera*)	technical grade (>97.5%)	<0.25 mg/kg[1]	NA	ECOTOX #79198 Fielder, 1987	supplemental

[1] 64.0% mortality at 0.25 mg/kg methamidophos in sugar syrup after 14 days.

These insect toxicity studies with methamidophos classify methamidophos as highly toxic (LD_{50} <2 µg/bee) to bees and beneficial insects on an acute contact basis. A honey bee acute contact toxicity study indicated that methamidophos is highly toxic to bees on an acute contact basis with an **LD50** of **1.37 µg a.i./bee** (MRID 36935, Atkins, 1975). Using an average adult honey bee weight of 0.128 g, this equates to 10.7 µg a.i./g bw.

Table D.72. Target Insect Acute Toxicity for Methamidophos[1]					
Species	% ai	LC_{50}/LD_{50}	Exposure Type	MRID No. Author/Year	Study Classification
Lepidoptera species					
Diamondback moth larvae (*P. xylostella)*	technical grade	26.7 µg/g (48 hr)	topical	ECOTOX #103261 Yu & Nguyen, 1996	open literature study
Douglas-fir tussock moth larvae (*H. pseudotsugata)*	technical grade	32.8 µg/g bw (7 day)[2]	topical	ECOTOX #53649 Robertson & Lyon, 1973	open literature study
Oriental fruit moth larvae (*G. molesta)*	technical grade	54.7 µg/g (2 hr)	spray	ECOTOX #63915 Pree et al., 1998	open literature study
Tobacco budworm larvae (*H. virescens)*	technical grade	85.7 µg/g bw (72 hr)[3] 57.1 µg/g bw (120 hr)[4]	topical	ECOTOX #152802 Rose & Sparks, 1984	open literature study
Western spruce budworm larvae (*C. occidentalis)*	**99.3**	**7.45 µg/g (24 hr)**	**topical**	**48650403 ECOTOX #153300 Mohamad & Oloffs, 1987**	**open literature study**
Coleoptera species					
Boll weevil adult (*A. grandis grandis)*	technical grade	128.6 µg/g bw (72 hr)[5]	topical	ECOTOX #152802 Rose & Sparks, 1984	open literature study

[1] Target insect studies are not typically used in assessments of the risks to non-target species. However, this endangered species assessment includes a Lepidoptera species and a Coleoptera species and studies on insects in these orders were therefore considered here
[2] Average larvae weight was 77 mg. LD_{50} = 2.5 µg/larvae.
[3] Larvae weight range was 30-40 mg. Assuming avg weight of 35 mg, LD_{50} = 3.0 µg/larvae.
[4] Larvae weight range was 30-40 mg. Assuming avg weight of 35 mg, LD_{50} = 2.0 µg/larvae.
[5] Larvae weight range was 15-20 mg. Assuming avg weight of 17.5 mg, LD_{50} = 2.3 µg/weevil.

Using the toxicity categories for honey bees, these insect toxicity studies with methamidophos classify methamidophos as moderately toxic (LD_{50} = 2-11 µg/organism) to Lepidoptera and Coleoptera insects on an acute contact basis.

4.4.3 Terrestrial Invertebrates: Sublethal Effects and Additional Open Literature Information

A complete list of all the Lepidoptera and Coleoptera toxicity data for acephate and methamidophos is provided below. Other terrestrial invertebrate open literature studies are also summarized below. Although target toxicity information is not typically used in ecological risk assessments, these data were compiled earlier to use in assessing risk to listed Lepidoptera and Coleoptera species and is also included here for use as needed.

Lepidoptera studies

Eleven acute Lepidoptera acephate studies with comparable LD_{50} endpoints were identified in the open literature. The species in these studies included cotton bollworm (*Helicoverpa armigera*), diamondback moth (*Plutella* *xylostella*), Douglas-fir tussock moth (*Hemerocampa pseudotsugata*), gypsy moth (*Lymantria dispar*), Mediterranean flour moth (*Anagasta kuehniella*), oriental fruit moth (*Grapholita molesta*), soybean looper (*Pseudoplusia includes*), tobacco budworm (*Heliothis virescens*), and Western spruce budworm (*Choristoneura occidentalis*). All species were tested in their larval stage in a laboratory setting. Nine of the studies tested acute contact toxicity using a direct topical application to the larvae. The most sensitive species tested was the soybean looper (*P. includes*) with a 72-hr LD_{50} of 20.34 µg/g bw (MRID 48650402, ECOTOX 73702, Ottens et al., 1984). This equates to 0.66 µg/larvae, calculated based on the weight range of larvae provided in the study. This value will be used quantitatively to assess acute risk of acephate exposure to the BCB.

Five acute Lepidoptera methamidophos studies with comparable LD_{50} endpoints were identified in the open literature. The species in these studies included diamondback moth (*P. xylostella)*, Douglas-fir tussock moth (*H. pseudotsugata)*, oriental fruit moth (*G. molesta*), tobacco budworm (*H. virescens*), and Western spruce budworm (*C. occidentalis*). All species were tested in their larval stage in a laboratory setting. The most sensitive species tested was the Western spruce budworm (*C. occidentalis*) with a 24 hr LD_{50} of 7.45 µg/g bw. The larval weight was not provided in the study. This value will be used quantitatively to assess acute risk of methamidophos exposure to the BCB.

Coleoptera studies

Three acute Coleoptera acephate studies were identified using adult boll weevils (*Anthonomus grandis grandis*), adult coffee bean weevils (*Araecerus fasciculatus*), and adult mealybug destroyers (*Cryptolaemus montrouzieri*) (a beneficial insect, not a target species). The first two studies tested acute contact toxicity using a direct topical application and found LD_{50}s of >5700 µg/g bw (72 hr) and >300 µg/g bw (24 hr), respectively. The mealybug destroyer study used a foliar residue design and found a 48 hr LD_{50} of 988 mg/l (MRID 48650403, ECOTOX 153300, Mohamad and Oloffs, 1987).

One acute Coleoptera methamidophos study was identified using the adult boll weevil (*A. grandis grandis*). This study tested acute contact toxicity using a direct topical application and found an LD_{50} of 128.6 µg/g bw (72 hr). This equates to 2.3 µg/weevil.

Because the collection of Coleoptera studies with usable, definitive acute toxicity endpoints was small, all studies were on adult insects, and there was no EPA guideline to serve as a standard, these endpoints will not be used to quantitatively assess toxicity of acephate and methamidophos to the VELB. However, the studies will be used qualitatively to characterize hazard. In the absence of Coleoptera data, to evaluate direct risk to the VELB the honeybee toxicity data described above will be used.

Other terrestrial invertebrate studies

Roberts and Dorough studied the effects of acephate on two species of earthworms (ECOTOX 40531, 1983). The earthworm species (*Eisenia foetida* and *Lumbricus rubellus*) were exposed to technical grade acephate on filter paper in vials for 48 hrs. The LC_{50} for *E. foetida* was 851 µg/cm^2 (95% CI 525-1378) and the LC_{50} for *L. rubellus* was 692 µg/cm^2 (95% CI 424-1127). Acephate is classified as moderately toxic (LC_{50} = 100-1000 µg/cm^2) to both species on an acute basis. Acephate was the least toxic of five organophosphate pesticides (fonofos, malathion, parathion, chlorpyrifos, and acephate) tested on these two species of earthworms by an order of magnitude.

Acephate effects on bee colonies were studied by Stoner (ECOTOX 35475, 1985). All bee colonies that were fed 10 mg/kg acephate lost queens early in the study and were unable to rear new queens. Acephate was systemic in nurse bees, causing toxicity from glandular secretions fed to queens. Concentrations of 1 mg/kg or less were harmless to the worker bees, but exposure to just 0.1 mg/kg resulted in significant reduction of the surviving brood. The study concluded that infrequent encounters by honey bee foragers with acephate on crops at levels of 1 mg/kg (the NOAEC) or less could be harmless. However, foragers may encounter levels greater than 1 mg/kg in the field because of 6-9 day residue persistence and residual systemic activity of acephate in plants for up to 15 days.

Another study also investigated the effects of acephate on bee colonies (MRID 99762, Johansen, 1977). After exposure to acephate, brood cycles of some colonies were found to be permanently broken, and all of the bees were dead within 45-48 days. Depression in the numbers of wild foraging bees at all treated plots was apparent.

Measured seed and fruit production of northern bluebells (*Mertensia paniculata*) were significantly reduced from lack of pollination.

Severe impacts to yellow jacket wasps and ants were measured at 1 and 2 lb a.i./A acephate sprayed on forest (MRID 99763, Johansen, 1977). Temperature affected the exposure of wasps; wasps do not forage in cooler temperatures (39°F), whereas warmer temperatures (59°F) increase their activity out of the nest.

Phugare *et al.* (2012; ECOTOX No. 159053) calculated an earthworm LOAEL of 5 mg/kg soil (based on protein carbonyls, superoxide dismutase enzyme activity, lipid peroxidation and coelomocytes damage).

5 Toxicity to Plants

5.1 Terrestrial Plants

Plant toxicity data from both registrant-submitted studies and studies in the scientific literature were reviewed. Registrant-submitted studies were conducted under conditions and with species defined in EPA toxicity test guidelines. Sublethal endpoints such as plant growth, dry weight, and biomass were evaluated for both monocots and dicots, and effects were evaluated at both seedling emergence and vegetative life stages. Guideline studies generally evaluate toxicity to ten crop species. These tests were conducted on herbaceous crop species only, and extrapolation of effects to other species, such as the woody shrubs and trees and wild herbaceous species, contributes uncertainty to risk conclusions.

Commercial crop species have been selectively bred, and may be more or less resistant to particular stressors than wild herbs and forbs. The direction of this uncertainty for specific plants and stressors, including acephate, is largely unknown. Homogenous test plant seed lots also lack the genetic variation that occurs in natural populations, so the range of effects seen from tests is likely to be smaller than would be expected from wild populations.

Acephate's neurotoxic mode of action does not apply to plant physiology so effects on plants would not be expected. Additionally, acephate has been used as an agricultural insecticide on a wide variety of crops for decades, indicating its absence of negative effect on these crops.

5.1.1 Studies using the parent chemical, acephate

Table D.73. Terrestrial Plant Toxicity for Acephate: Non-Guideline

MRID	Author, Year	Phytotoxicity Information
00014623	Davis, 1977	Orthene Insect Spray formulation (15.6% a.i.) tested on poinsettia at 0.75 lb / 100 gal. applied up to 3X. Phytoxicity symptoms observed on plants (tomato, watermelon, fuchsia, begonia, *Hedra helix*, and philodendron, angelwings, coleus, poinsettia, *Chrysanthemum* spp., *Diffenbachia picta, Gynura aurantiaca,* and *Dracaena marginata*) were slight tip burn and foliar distortion, marginal leaf necrosis, slight leaf chlorosis caused by formulation. The technical grade acephate, whenever it was tested, did not cause any leaf damage. The formulation with methyl cellosolve caused some tip burn and foliar distortion on new growth.
00014928	Shaefer, 1975	Marginal necrosis and slight stunting on18 inch tall *Viburnum suspensum* from 2 applications of 1 lb /100 gal water of Orthene formulation. Fourteen other different species of nursery plants tested with no symptoms of effects.
00014929	Clark, 1975	Slight to mild phytotoxicity symptoms on leaves for Lombardy cottonwood from 2 applications of 0.5 lb and 1.0 lb ai/A. Sixty different species of nursery plants tested with no symptoms of effects. No information provided as to what formulation of acephate was used.

Table D.74. Terrestrial Plant Toxicity for Acephate: Vegetative Vigor Tier II Reference: Porch, J.R., *et al.*, 2003; MRID 46173204					
Crop	Plant height[1]		Dry weight[1]		Most sensitive parameter
	NOEC	EC_{25}	NOEC	EC_{25}	
Onion	3.96	>3.96	3.96	>3.96	None
Ryegrass	3.96	>3.96	3.96	>3.96	None
Wheat	3.96	>3.96	3.96	>3.96	None
Corn	3.96	>3.96	3.96	>3.96	None
Buckwheat	3.96	>3.96	3.96	>3.96	None
Soybean	3.96	>3.96	3.96	>3.96	None
Lettuce	3.96	>3.96	3.96	>3.96	None
Flax	3.96	>3.96	3.96	>3.96	None
Tomato	3.96	>3.96	3.96	>3.96	None
Radish	3.96	>3.96	3.96	>3.96	None

[1] Units are lb ai/A. 3.96 lb ai/A is equivalent to 4.50 kg a.i./ha.

Table D.75. Terrestrial Plant Toxicity for Acephate: Seedling Emergence Tier II Reference: Porch, J.R., *et al.*, 2003; MRID 46173203									
Crop	Emergence[1]		Survival[1]		Plant height[1]		Dry weight[1]		Most sensitive parameter
	NOEC	EC_{25}	NOEC	EC_{25}	NOEC	EC_{25}	NOEC	EC_{25}	
Onion	3.96	>3.96	3.96[2]	>3.96	3.96	≤3.96[2]	3.96	3.96[2]	Dry weight[3]
Ryegrass	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Wheat	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Corn	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Buckwheat	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	Plant height[4]
Soybean	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Lettuce	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Flax	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Tomato	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None
Radish	3.96	>3.96	3.96	>3.96	3.96	>3.96	3.96	>3.96	None

[1] Units are lb ai/A. 3.96 lb ai/A is equivalent to 4.50 kg a.i./ha.
[2] Plant height and dry weight reduction were >25% (27 and 34%, respectively) for the highest treatment group, though not significantly different from the control due to varability.
[3] The study author discounted the >25% inhibition exhibited by onion height and biomass because these responses did not follow a clear dose-dependent pattern.
[4] The 7% inhibition exhibited by buckwheat height did not follow a clear dose-dependent pattern.

The results of the Tier II seedling emergence and vegetative vigor toxicity tests with acephate on non-target plants are summarized above (MRIDs 46173203, 46173204, Porch et al., 2003). The NOAEC for acephate seedling emergence and vegetative vigor studies was 3.96 lb ai/A.

5.1.2 Studies using the degradate, methamidophos

Table D.76. Terrestrial Plant Toxicity for Methamidophos: Seedling Emergence Tier I Reference: Christ & Lam, 2005: MRID 46655802						
Species	% ai	% inhibition length	% inhibition weight	Maximum Dose	MRID No. Author, Year	Study Classification
Cabbage	42.6	3	0	4 lb ai/A	46655802 Christ and Lam, 2005	acceptable
Corn		0	0			
Cucumber		2	0			
Lettuce		0	3			
Oat		0	0			
Onion		3	0			
Radish		0	6			
Ryegrass		0	0			
Soybean		2	0			
Tomato		15	0			

Table D.77. Terrestrial Plant Toxicity for Methamidophos: Vegetative Vigor Tier I Reference: Christ & Lam, 2005: MRID 46655802						
Species	% ai	% inhibition length	% inhibition weight	Maximum Dose	MRID No. Author, Year	Study Classification
Cabbage	42.6	0	6	4.0 lb ai/A	46655802 Christ and Lam, 2005	acceptable
Corn		3	1			
Cucumber		0	1			
Lettuce		5	4			
Oat		4	8			
Onion		1	4			
Radish		6	5			
Ryegrass		0	0			
Soybean		1	4			
Tomato		0	6			

Tier I seedling emergence and vegetative vigor toxicity tests using 4.0 lb a.i./A methamidophos found no significant effects (MRID 46655802, Christ and Lam, 2005). The NOAEC for methamidophos seedling emergence and vegetative vigor studies was 4.0 lb ai/A.

5.1.3 Terrestrial Plants: Open Literature

Three open literature studies testing the effects of acephate products on plants were identified. A study using a 0.75 lb/100 gal insect spray formulation (a typical concentration for acephate products) with methyl cellosolve, with up to three applications, recorded foliar distortion, marginal leaf necrosis, and slight leaf chlorosis on multiple ornamental plants (MRID 00014623, Davis, 1977). However, tests in this study with technical grade acephate did not cause any leaf damage. A second study using a formulation found marginal necrosis and slight stunting on *Viburnum suspensum* from two applications of 1 lb/100 gal solution but did not see any effects on 14 other species of nursery plants (MRID 00014928, Shaefer, 1975). A third study, using an unknown formulation of acephate, observed slight to mild phytotoxicity symptoms on leaves of the Lombardy cottonwood after two applications of 0.5 lb and 1 lb/A (MRID 00014929, Clark, 1975). This study tested 60 other nursery plants with no observed effects. No open literature studies on the effects of methamidophos on plants were available.

5.2 Aquatic Plants

Aquatic plant toxicity studies are used as one of the measures of effect to evaluate whether acephate or methamidophos may affect primary production. Aquatic plants may also serve as dietary items and habitat components for aquatic animals.

5.2.1 Studies using the parent chemical, acephate

Table D.78. Aquatic Plant Toxicity for Acephate					
Species	% ai	NOAEC (mg a.i./L)	EC_{50} (mg a.i./L)	MRID No. Author/Year	Study Classification
Nonvascular Aquatic Plants:					
Diatom *(Skeletonema costatum)*	94	Not provided[1]	>50	40228401 Mayer, 1986	supplemental
Green Algae (*Pseudokirchneriella subcapitata*)	98.8	1035[2]	>1035 (95% CI N/A)	48879501 Burlingham, 2012	acceptable
Diatom (*Nitzchia* sp.)	98.4	Not provided – assumed as <1.36	0.30	Tien and Chen, 2012	supplemental - qualitative
Vascular Aquatic Plants:					
Duckweed (*Lemna gibba*)	98.8	253[3]	>1038 (95% CI 1026 to 1051)[4]	48879503 Burlingham, 2012	acceptable

N/A = not applicable.
[1] Previous acephate assessments have attributed a NOAEC of 5.0 mg/L to this study, but the source of that number was unclear.
[2] Based on no effects seen at the highest concentration tested in yield, growth rate and area under curve. An EC_{05} of 561 (95% CI: N/A to 1060) mg a.i./L was calculated based on yield.
[3] Based on dry weight biomass and growth rate. An EC_{05} of 172 (95% CI: N/A to 263) mg a.i./L was calculated based on final dry weight biomass.
[4] Based on frond number yield.

In previous assessments only one non-vascular aquatic plant study and no vascular aquatic plant studies had been available for acephate. The non-vascular aquatic plant study found the EC_{50} for a diatom (*Skeletonema costatum*) to be >50 mg/L (MRID 40228401, Mayer, 1986). This study was recorded as part of a larger report and classified as supplemental because of a lack of raw data and study specific details. No NOAEC was reported and the lack of raw data prevented the use of additional statistical analysis to determine this endpoint. This acephate non-vascular aquatic plant endpoint had also been used for methamidophos assessments in the past due to a lack of aquatic plant data for methamidophos.

Recently reviewed studies (MRID 48879501 and 48879503, respectively) showed an EC_{50} of >1035 for green algae and >1038 for duckweed. A search of the open literature also revealed a more sensitive endpoint for the diatom than that of the green algae. Tien and Chen (2012; ECOTOX No. 157805) calculated a 96-hour EC_{50} of 0.30 mg/L for *Nitzchia*. This study was considered supplemental information from the open literature and the data could not be confirmed. The test concentrations were widely spaced in the study: 0.1, 1, 10, 50, 100, 200 and 400 mg/L, supporting data were unavailable and methanol was used as a solvent at concentrations above recommended without confirmation of no solvent effect. Since the goodness of fit of the regression reportedly was good (R^2 of 0.99 and p of <0.001) the endpoint may be used to characterize risk but is considered too uncertain to use in calculating risk.

5.2.2 Studies using the degradate, methamidophos

Table D.79. Aquatic Plant Toxicity for Methamidophos.					
Species	% ai	NOAEC (mg a.i./L)	EC_{50} (mg a.i./L)	MRID No. Author/Year	Study Classification
Nonvascular Aquatic Plants:					
Green Algae (*P. subcapitata*)	86.1	29.5[1]	679[2] (95% CI 523-882)	48879502 Burlingham, 2012	acceptable
Vascular Aquatic Plants:					
Duckweed (*L. gibba*)	86.1	1.42[3]	3.65 (95% CI 3.29 to 4.05)[4]	48879504 Burlingham, 2012	acceptable

N/A = not applicable.
[1] Based on area under curve. An EC_{05} of 49.4 mg a.i./L was calculated based on yield.
[2] Based on yield.
[3] Based on Frond number yield and growth rate and dry weight biomass and growth rate. An EC_{05} of 0.86 (95% CI: N/A to 1.42) mg a.i./L was calculated based on final dry weight biomass.
[4] Based on frond number yield.

The acephate diatom endpoint (listed above) has been used as a surrogate in previous risk assessments. Recently reviewed studies, now available, show methamidophos to be more toxic to vascular than nonvascular aquatic plants, with respective LC_{50}'s of 3.65 and 679 and NOAEC's of 1.42 and 29.5 mg a.i./L.

The neurotoxic mode of action of both acephate and methamidophos, like other organophosphate insecticides, is not applicable to plant physiology. Overall, the weight of evidence suggests that the risk to aquatic plants from exposure to methamidophos is unlikely. No open literature studies have been located for methamidophos toxicity to aquatic plants.

6 Field Testing and Literature Findings

6.1 Terrestrial Organisms

Table D.80. Terrestrial Field Studies and Incidents for Acephate		
Terrestrial Organism	Summary	Reference
Sparrows	Migratory white-throated sparrows (*Zonotrichia albicollis*) were exposed to acephate to determine its effects on migratory orientation and behavior. Birds were exposed to polarizer sheets to determine the mechanism by which acephate may affect migratory orientation. Adult birds exposed to 256 mg a.i./kg were not able to establish a preferred migratory orientation and exhibited random activity. All juvenile treatment groups displayed a seasonally correct southward migratory orientation. The author hypothesized that acephate may have produced aberrant migratory behavior by affecting the memory of the adult's migratory route and wintering ground. The "experiment reveals that an environmentally relevant concentration" (similar to 0.5 lb ai/A application) of an OP such as acephate "can alter migratory orientation, but its effect was markedly different between adult and juvenile sparrows. Results suggest that the survival of free-flying adult passerine migrants may be compromised following organophosphorus pesticide exposure."	ECOTOX #40313 Vyas et. al., 1995
Birds	Acephate was sprayed in a forest at 0.5 lb ai/A. Eleven species of birds had ChE inhibition that ranged on average from 20 to 40%. The maximum depression of ChE found in chipping sparrows was 57% at day six. Western tanager species was found to have significant inhibition up to 26 days after application. Brain residue analysis of a western tanager collected on day three contained 0.318 mg/kg of acephate and 0.055 mg/kg of methamidophos. The authors concluded that brain ChE inhibition that occurred from forest application of 0.5 lb. ai/A was sufficient to be life threatening to the birds.	Zinkl et al.. 1979.[1]
Sparrows	The effects of a 14-day dietary exposure of acephate on cholinesterase activity in three regions; basal ganglia, hippocampus, and hypothamulus were examined in the brain of the white-throated sparrow, *Z. albicollis*. All three regions experienced depressed cholinesterase activity between 0.5-2 mg ai/kg acephate. The regions exhibited cholinesterase recovery at 2-16 mg ai/kg acephate; however, cholinerase activity dropped and showed no recovery at higher dietary levels (> 16 mg ai/kg) which suggests that each region maintains its own ChE activity level integrity until the brain is saturated. Each region of the brain is responsible for different survival areas such as a foraging and escaping predators, memory and spatial orientation, food and water intake, reproduction and several others. Evidence indicated that the recovery is initiated by the magnitude of depression, not the duration. In general, as acephate concentration increased, depression in ChE activity among brain regions increased and differences of ChE activity among the three brain regions decreased. The pattern of ChE depression in different regions of the brain following low level exposure may prove to be a critical factor in the survival of the bird. The authors hypothesized that adverse effects to birds in the field may occur at pesticide exposure levels customarily considered negligible.	ECOTOX #40343 Vyas et. al., 1996
Passerine birds	Several large acreages of forest were sprayed with 0.5, 1.0 or 2.0 lb ai/A application rates. There was no brain ChE inhibition on day zero after application. Birds collected from the 2 lb ai/A plots from day one through six post spray showed ChE inhibition. Brain ChE inhibition was shown in birds 33 days after treatment but not 89 days after treatment. Birds seemed to have more inhibition of ChE in summer application when compared to the fall application in the 1 lb ai/A plots (30-50% and 25-40% depression, respectively). The greatest ChE inhibition occurred in dark-eyed juncos (65%) collected 15 days after treatment. In the 2 lb ai/A plots, dark-eyed juncos and golden-crowned kinglets had 54% ChE inhibition. Of the 14 species collected, only pine siskins *(Siinus pinus)* did not show any ChE inhibition. Symptoms of organophosphate poisoning were observed such as a warbling vireo salivating profusely, an American robin having difficulty maintaining a perching position, and a mountain chickadee having visible tremors. All of these observations were made in the 1 lb ai/A plots. The authors concluded that since marked ChE inhibition did not occur on day zero, but was evident up to 33 days after application, there was either an accumulative effect that was detected later or acephate was converted to a more potent ChE inhibitor such as methamidophos. Spraying the forest with 0.5, 1.0 or 2.0 lb ai/A caused marked and widespread, and prolonged ChE depression in passerine birds.	Zinkl, 1977[1]
Red-eye Vireos	Site: Acephate was applied in this study on June 13 at 0.55 kg/ha (0.5 lb ai/A) on two 200 hectare plots. Significant ($P<0.05$) decline in number of red-eyed vireos was observed. The decline was concentrated in the interior of the treated plots rather than spread throughout. The authors concluded that this was directly attributed to acephate.	05014922, 00163173 Bart, 1979

Table D.80. Terrestrial Field Studies and Incidents for Acephate		
Terrestrial Organism	Summary	Reference
American Kestrels	Kestrels were dosed with 50 mg/kg of 75% acephate formulation. Serum ChE was 37% inhibited and returned to predosed levels eight days later. Then the birds were dosed again and the serum ChE activity was inhibited at 42%; brain ChE was at 26% inhibition. The kestrel prey-catching activity was not altered.	00141694 Rudolph, 1984
Forest birds	Site: Wallowa-Whitman National Forest. Applications of 1.12 (1.0 lb ai/A) and 2.24 (2.0 lb ai/A) kg/ha were made on forest plots in Oregon. Extensive inhibition of brain ChE activity (commonly at 30-50%) for up to 33 days for 11 of the 12 species of birds that were collected was observed. The highest frequency of ChE inhibition was observed on day two post spray. Two species of birds had observable population decreases. Some birds on the plots treated with 1.12 kg/ha had 65% ChE inhibition which is considered to be fatal amounts. At both plots, birds were found with coordination problems, salivating profusely, and unable to fly. These behaviors were observed up to 20 days after application in the 2.24 kg/ha plot. It was also observed that breeding pairs for the warbling vireo and yellow-rumpled warbler decreased. The authors concluded that application of acephate at rates of 1.12 and 2.24 kg/ha can cause sickness and death to forest birds.	40644802 Richmond, 1979
Birds	Site: Seven western states. USDA applied 1.05 oz ai/A ULV aerially for grasshopper control in 38,000 to 51,000 acre plots in May 1980. Most birds collected showed reduced brain ChE activity. The greatest inhibitions were found in the last birds collected. Horned larks showed more than 20% inhibition at the end of the 24-day post spray period. Some of these birds were showing 40% inhibition of brain ChE.	00032188 Mazuravich, 1972
Birds and Deer Mice	Site: WY, UT and AZ rangeland. In 1979 and 1980, the birds and small mammals collected up to 24 days after application had reduced ChE activity. Reduction of 20% or more is indicative of exposure to brain ChE inhibitor. Of the birds collected in AZ, 24.5% had reduced ChE activity >20%. The birds with the most ChE inhibition were the last ones collected (21-24 days post treatment). In 1981, horned larks and lark buntings were collected in WY on a 12,000 acre plot that was treated with acephate at the rate of 0.105 kg/ha. More than 20% ChE inhibition was found in 19% of the horned larks and 25% of the lark buntings. Deer mice were also collected in WY. They were found to have ChE inhibition that ranged from 12.7% to 14.6%.	00093909 McEwen, 1981
Squirrel	There was a marked inhibition of brain ChE activity in squirrels after aerial treatment of forests at rates of 0.57 kg/ha (0.51 lb/A) of Orthene.	40329701 Zinkl, 1980
Insectivorous mammals	Increased ingestion of arthropods by insectivorous mammals has been reported following acephate application. This signifies a direct pathway for substantial exposure to acephate due to consumption of dead and dying insects.	Stehn, et. al., 1976[1]
Queen bees	Acephate appears to be systemic in nurse bees, causing glandular secretions fed to queens to be toxic. All colonies fed the 10 mg/kg rate lost queens early in the study and the affected colonies were unable to rear new queens. The study implied infrequent encounters by honey bee foragers with acephate on crops at levels of 1 mg/kg (1 mg/kg was NOAEC level) or less should be harmless. However, foragers may be expected to encounter levels greater than 1 mg/kg in the field because of 6-9 day residue persistence and residual systemic activity of acephate in plants for up to 15 days. Consequently, the study concluded that acephate was a hazard to honey bees because of its high contact toxicity, and because of its systemic nature.	ECOTOX #35475 Stoner et. al., 1984
Honey bees	Orthene was found to be more detrimental to honey bee populations than carbaryl. Brood cycles of some colonies were found to be permanently broken, so the colonies were technically dead. Depression in the numbers of wild foraging bees was apparent. Measured seed and fruit production of various plants were reduced from lack of pollination.	00099762 Johansen, 1977
Yellow jacket wasps and ants	Severe impacts on yellow jacket wasps and ants at rates of application of 1 and 2 lb ai/A sprayed on forest. Temperature seems to affect the exposure of wasps in that cooler temperature (39ºF) causes wasps not to forage out of nests and therefore not be exposed as much, whereas warmer temperatures (59ºF) increases the activity of wasps and the exposure to acephate.	00099763 Johansen, 1977

[1] Citation found in **References** section.

6.2 Aquatic Organisms

Table D.81. Aquatic Field Studies for Acephate		
Aquatic organism	Summary	Reference
Fish	Site: Moosehead Lake, ME. A 75% acephate formulation was applied at 0.5 lb. ai/A on forest. Brook trout and landlocked salmonoid did not show any decreases in ChE activity but suckers, a bottom feeder, showed 28% drop in ChE activity. There was a gradual return to pre spray ChE activity by eight days after treatment. The brook trout changed their diet a few days after spraying in response to the killed arthropods entering the stream. Macro invertebrates increased drift into the stream moderately and temporarily from the spraying. The invertebrate standing crop was not affected. Salmonoid growth was unaffected and newly hatched smelt grew normally.	00014547, 05012201 Rabeni, 1979
Fish	Site: Two forest ponds and a stream in PA. 0.5 lb. ai/A was applied to two forest ponds and a stream in PA, where 65 caged fish (bluegills, perch, and bullheads) were held. The fish and the sampled benthic invertebrates showed no effect up to eight days post treatment. The authors concluded that the "aquatic ecosystem under study was not significantly affected."	00014637 Bocsor, 1975
Fish and invertebrates	Author compared Orthene with Sumithion, Carbaryl, Dylox, Matacil, and Dimilin regarding brook trout, Atlantic salmon, scud and stoneflies. Author concluded that "Orthene should not pose any significant toxicity hazard to fish or (aquatic) invertebrates" when compared to the other chemicals.	00014861 Schoettger, 1976
Fish and invertebrates	Direct application to stream for 5 hour at concentration of 1000 ppb from 8 a.m. to 1 p.m. Measurements of acephate remained constantly at 1100 to 1200 ppb during this time. No mortality was noted in trout and benthic insects in the stream.	EXOTOX #15677 Geen et. al., 1981
Rainbow trout	"Brain ChE activity was depressed (38.2%) in trout exposed for 24 hours to 400 mg acephate per liter. After 24 hours of being in uncontaminated water, brain ChE was still depressed (42.5%)." There was no significant difference in the 100 mg/L for ChE depression when compared to control. Brain ChE activity remains depressed 8 days after a 24-hour exposure to 25 mg/L of methamidophos and 15 days after exposure to 400 mg/L of acephate. Because of low toxicity of acephate to rainbow trout, the study failed to determine at what % ChE inhibition would cause death. The level of depression that suggests poisoning by acephate or methamidophos was greater than 70% since brain ChE inhibition was at least this much in some trout that did not die. There was persistent ChE depression (8 days for methamidophos and 15 days for acephate) which suggests sublethal effects such as inability to sustain physical activity in search of food, eluding predators, and maintaining position in flowing water would occur. The author suggested that trout could die as a indirect result of sublethal toxicity.	ECOTOX #12398 Zinkl et. al., 1987
Mussels and clams	Reports of mussel die-off occurring in North Carolina prompted this study (See Fleming et. al. 1995). *Elliptio complanata* (freshwater mussel) and *Corbicula fluminea* (asiatic clam) were both tested. *E. complanata* ChE depression was significant at 1.3 mg/L at the adductor muscle at 21°C at 96 hour exposure (no mortality was observed). When the temperature was raised to 30°C, there was significant mortality at observed at 5 mg/L. Cholinesterase activities of the adductor muscle (which was depressed 94-96%), began to recover 12 days after exposure, but was not fully recovered until more than 24 days after exposure. Acephate reduced the shell closure responsiveness at 5 mg/L with more pronounced affect at 27°C. This appears to confirm a die-off of mussels in North Carolina in August at a time of low water flow and seasonally peaked temperatures. When compared to carbamates, recovery was less rapid due to the accepted generalization (O'Brien, 1976) that OP chemicals irreversibly bind (phosphorylation) to ChE sites whereas carbamates reversibly bind (carbamylation) to ChE sites.	ECOTOX #52429 Moulton et. al., 1996

Table D.81. Aquatic Field Studies for Acephate		
Aquatic organism	Summary	Reference
Mussels	"In 1990, we investigated a die-off of freshwater mussels in north-central North Carolina. An estimated 1,000 mussels of several species were found dead or moribund, including about 111 Tar spinymussels (Elliptio steinstansana), a federally listed endangered species. The die-off occurred during a period of low flow and high water temperature in a stream reach dominated by forestry and agriculture. Pathological examinations did not show any abnormalities and indicated that the die-off was an acute event. Chemical analyses of mussels, sediments, and water revealed no organophosphorus or carbamate pesticides. Cholinesterase activity in adductor muscle from Eastern elliptios (E. complanata) collected at the kill site and downstream was depressed 73 and 65%, respectively, compared with upstream reference samples. The depression was consistent with a diagnosis of anticholinesterase poisoning. This was the first documented case in which cholinesterase-inhibiting compounds have been implicated in a die-off of freshwater mussels."	Fleming et. al., 1995[1]

[1] Citation found in **References** section.

7 References for Cited Documents Other Than Submitted Studies or ECOTOX Publications

Please note that references for submitted studies are found in **Appendix C** and for ECOTOX publications in **Appendix E**.

Berteau, P.E., R.E. Chiles. 1978. Studies on the Inhalation Toxicity of Two Phosphoramidothioate Insecticides to Rodents and Quail. University of California, School of Public Health, Naval Biosciences Laboratory, Naval Supply Center, Oakland, California.

Fleming, W.J., Augspurger, T.P. and Alderman, J.A., 1995. Freshwater mussel die-off attributed to anticholinesterase poisoning. *Environ. Toxicol. Chem.*, 14: 877-879.

Smith, G.J., 1987. Pesticide Use and Toxicology in Relation to Wildlife: Organophorous and Carbamate Compounds. U.S. Dept. of Interior, FWS Resource Publication 170. pg. 71.

Stehn, R.A., J.A. Stone and M.E. Richmond. 1976. Feeding Response of Small Mammal Scavengers to Pesticide-killed Arthropod Prey. *American Midland Naturalist*. 95(1):253-256. University of Notre Dame

USEPA. 2004. *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs*. United States Environmental Protection Agency (USEPA). Environmental Fate and Effects Division. Office of Pesticide Programs. Available at http://www.epa.gov/espp/consultation/ecorisk-overview.pdf (Accessed June 19, 2009).

USEPA. 2006. Reregistration Eligibility Decision (RED) Document for Acephate, EPA -HQ-OPP-2006-0618, July 2006.

USEPA. 2007a. Risks of Acephate Use to the Federally Listed California Red Legged Frog (*Rana aurora draytonii*), July 2007. Available at: <http://www.epa.gov/espp/litstatus/effects/redleg-frog/acephate/analysis_acephate.pdf>.

USEPA. 2007b. Risks of Methamidophos Use to the Federally Listed California Red Legged Frog (*Rana aurora draytonii*), July 2007.

USEPA. 2011. Gelmann, Elyssa and R. David Jones, December 19, 2011, "Risks of Acephate Use to the Federally Threatened Bay Checkerspot Butterfly (*Euphydryas editha bayensis*), Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*), and California Tiger Salamander (*Ambystoma californiense*), Central California Distinct Population Segment And the Federally Endangered California Clapper Rail (*Rallus longirostris obsoletus*), California Freshwater Shrimp (*Syncaris pacifica*), California Tiger Salamander (*Ambystoma californiense*) Sonoma County Distinct Population Segment and Santa Barbara County Distinct Population Segment, Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*), San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*), and San Joaquin Kit Fox (*Vulpes macrotis mutica*)," U.S. Environmental Protection Agency, Office of Pesticide Programs, http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/2011/acephate2/analysis.pdf.

USEPA. 2011b. Evaluation Guidelines for Ecological Toxicity Data in the Open Literature. Memo from Donald Brady, Director, Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency. May 16, 2011.

Zinkl, J. G., C.J. Henny, and P.J. Shea. 1979. Brain cholinesterase activities of passerine birds in forests sprayed with cholinesterase inhibitors. Pages 356-365. In: Animals as Monitors of Environmental Pollutants, National Academy of Science, Washington, DC.

Zinkl, J.G., C.J. Henny, and L.R. DeWeese. 1977. Brain cholinesterase activities of birds from forests sprayed with trichlorfon (Dylox) and carbaryl (Sevin-4-oil). *Bull. Environ. Contam. Toxicol*. 17:379-386.

APPENDIX E. ECOTOX List of Accepted Papers

Acephate Refresh Acceptable Bibliography April 2014

1. Abou-Awad, B. A. and El-Banhawy, E. M. Susceptibility of the Tomato Russet Mite, Aculops lycopersici (Acari: Eriophyidae), in Egypt to Methamidophos, Pyridaphenthion, Cypermethrin, Dicofol and Fenarimol. MOR1985; 1, (1): 11-15.
   Rec #: 1080
   Call Number: LITE EVAL CODED (CYP,DCF,FRM,MTM), TARGET2012 (CYP,DCF,MTM)
   Notes: EcoReference No.: 100336
   Chemical of Concern: CYP,DCF,FRM,MTM

2. Acosta, N.; Cruz, C., and Negron, J. Insect and Nematode Control in Cucumber (Cucumis sativus) in Puerto Rico. POP1986; 70, (1): 19-24.
   Rec #: 10
   Call Number: LITE EVAL CODED (ACP,DMT,EP,MOM,MTM,OML), OK (ADC,CBF,PMR)
   Notes: EcoReference No.: 153453
   Chemical of Concern: ACP,ADC,CBF,DMT,EP,MOM,MTM,OML,PMR

3. Adams, R. G. Jr.; Lilly, J. H., and Gentile, A. G. Effects of Certain Systemic Insecticides on Gladiolus Growth and Spike Production. GRO,REP. Dep. Entomol.,Univ. Massachusetts,Amherst,MA//: 1975; 68, (5): 727-728.
   Rec #: 610
   Call Number: LITE EVAL CODED (ACP,ADC,CBF,DMT,DS,OML,OXD), NO EFFECT (BMY)
   Notes: EcoReference No.: 103899
   Chemical of Concern: ACP,ADC,BMY,CBF,DMT,DS,OML,OXD,PIM

4. All, J. N. and Jellum, M. D. Efficacy of Insecticide-Nematocides on Sphenophorus callosus and Phytophagous Nematodes in Field Corn. POP1977; 12, (4): 291-297.
   Rec #: 680
   Call Number: LITE EVAL CODED (ACP,CPY,EP,OML), OK (ADC,CBF,PRT,TBO)
   Notes: EcoReference No.: 39684
   Chemical of Concern: ACP,ADC,CBF,CPY,EP,EPRN,FNF,IFP,OML,PHSL,PRN,PRT,TBO

5. Alyokhin, A.; Makatiani, J., and Takasu, K. Insecticide Odour Interference with Food-Searching Behaviour of Microplitis croceipes (Hymenoptera: Braconidae) in a Laboratory Arena. BEH2010; 20, (3): 317-329.
   Rec #: 1730
   Call Number: LITE EVAL CODED (EFV,IMC,MTM,NNCT)
   Notes: EcoReference No.: 157546
   Chemical of Concern: EFV,IMC,MTM,NNCT,SS

6. Anwar, R. Population Dynamics of the Cotton Aphid, Aphis gossypii Glover (Homoptera: Aphididae), and Its Fungal Pathogen, Neozygites fresenii (Nowakowski) Batko (Entomophthorales: Neozygitaceae), in South Carolina. POP2008: 143 p. (UMI# 3306703).
   Rec #: 1680
   Call Number: LITE EVAL CODED (ACP,DCTP), OK (IMC,LCYT,NNCT)
   Notes: EcoReference No.: 156321
   Chemical of Concern: ACP,ACT,DCTP,EMMB,IDC,IMC,LCYT,NNCT,SS,TMX

7. Bacci, L.; Crespo, A. L. B.; Galvan, T. L.; Pereira, E. J. G.; Picanco, M. C.; Silva, G. A., and Chediak, M. Toxicity of Insecticides to the Sweetpotato Whitefly (Hemiptera: Aleyrodidae) and Its Natural Enemies. MOR2007; 63, (7): 699-706.
   Rec #: 1150
   Call Number: LITE EVAL CODED (ACP,MLN,MTM), NO ENDPOINT

(BFT,CYP,DM,EFV,FNT,FPP,PMR,TCF), OK (IMC,NNCT)
Notes: EcoReference No.: 102813
Chemical of Concern:
ABM,ACP,ACT,BFT,CYP,DM,EFV,FNT,FNTH,FPP,IMC,MLN,MTM,NNCT,PMR,TCF

8. Bacci, L.; Picanco, M. C.; Barros, E. C.; Rosado, J. F.; Silva, G. A.; Silva, V. F., and Silva, N. R. Physiological Selectivity of Insecticides to Wasps (Hymenoptera: Vespidae) Preying on the Diamondback Moth. MOR2009; 53, (1): 151-167.
Rec #: 1740
Call Number: LITE EVAL CODED (DM,MTM), OK (CBL,MP,TCF)
Notes: EcoReference No.: 157494
Chemical of Concern: CBL,DM,MP,MTM,TCF

9. Bacci, L.; Picanco, M. C.; Rosado, J. F.; Silva, G. A.; Crespo, A. L. B.; Pereira, E. J. G., and Martins, J. C. Conservation of Natural Enemies in Brassica Crops: Comparative Selectivity of Insecticides in the Management of Brevicoryne brassicae (Hemiptera: Sternorrhyncha: Aphididae). MOR2009; 44, (1): 103-113.
Rec #: 1750
Call Number: LITE EVAL CODED (ACP,DM,DMT,MTM)
Notes: EcoReference No.: 157446
Chemical of Concern: ACP,DM,DMT,EPRN,MTM,PRN

10. Bacci, L.; Rosado, J. F.; Picanco, M. C.; Pereira, E. J. G.; Silva, G. A., and Martins, J. C. Concentration-Mortality Responses of Myzus persicae and Natural Enemies to Selected Insecticides. MOR2012; 47, (12): 1930-1937.
Rec #: 1830
Call Number: LITE EVAL CODED (ACP,DMT,MTM), OK (DM)
Notes: EcoReference No.: 162810
Chemical of Concern: ACP,DM,DMT,EPRN,MTM,PIM,PRN

11. Bacheler, J. S.; Mott, D. W.; Edmisten, K., and Straughn, E. Effect of Selected Insecticides for Thrips Control on Cotton, 1996. GRO,POP1997; 22, 240-(46F).
Rec #: 20
Call Number: LITE EVAL CODED (ACP,ADC,DMT,DS,FPN,IMC,NNCT,PRT)
Notes: EcoReference No.: 151456
Chemical of Concern: ACP,ADC,DMT,DS,FPN,IMC,NNCT,PRT

12. Barbara, K. A. and Buss, E. A. Integration of Insect Parasitic Nematodes (Rhabditida steinernematidae) with Insecticides for Control of Pest Mole Crickets (Orthoptera: Gryllotalpidae: Scapteriscus spp.). MOR,PHY2005; 98, (3): 689-693.
Rec #: 930
Call Number: LITE EVAL CODED (ACP,DM), OK (BFT,DM,FPN,IMC,NNCT)
Notes: EcoReference No.: 113918
Chemical of Concern: ACP,BFT,DM,FPN,IMC,NNCT

13. Bayoun, I. M.; Plapp, F. W. Jr.; Gilstrap, F. E., and Michels, G. J. Jr. Toxicity of Selected Insecticides to Diuraphis noxia (Homoptera: Aphididae) and Its Natural Enemies. MOR1995; 88, (5): 1177-1185.
Rec #: 1180
Call Number: LITE EVAL CODED
(ACP,AMZ,CPY,DM,DMT,DZ,EFV,LCYT,MLN,MOM,MP,PFF,PMR,PRT)
Notes: EcoReference No.: 39997
Chemical of Concern:
ACP,AMZ,CPY,DM,DMT,DZ,EFV,LCYT,MLN,MOM,MP,PFF,PMR,PRT,SPS

14. Beam, J. B.; Jordan, D. L.; York, A. C.; Bailey, J. E.; Isleib, T. G., and McKemie, T. E. Interaction of Prohexadione Calcium with Agrichemicals Applied to Peanut (Arachis hypogaea L.).

GRO,PHY,POP2002; 29, (1): 29-35.
Rec #: 1700
Call Number: LITE EVAL CODED (ACP,BT,CBL,CLT,FPP,LCYT,MLN,SXD), NO EFFECT (AZX,BOR,CTN,CuOH,IPD,PPG), NO MIXTURE (Conazoles,PCZ,PPCP,PPCP2011)
Notes: EcoReference No.: 156938
Chemical of Concern: 24DBDMA,ACF,ACFNa,ACP,AZX,BOR,BT,CBL,CLT,CTN,Conazoles,CuOH,DMDB,FPP,IAZ,IPD,IZT,LCYT,MLN,NaB,PCZ,PPCP,PPCP2011,PPG,PYD,SXD,TEZ

15. Bellows, T. S. Jr. and Morse, J. G. Toxicity of Insecticides Used in Citrus to Aphytis melinus DeBach (Hymenoptera: Aphelinidae) and Rhizobius lophanthae (Blaisd.) (Coleoptera: Coccinellidae). MOR1993; 125, (6): 987-994.
Rec #: 1160
Call Number: LITE EVAL CODED (ACP,AZ,BFT,CBL,CPY,DMT,EFV,FPP,MOM,Naled,TAUF,TCF,TDC), OK (AMZ,FTT,FTTCl,FVL,MDT,MVP)
Notes: EcoReference No.: 59334
Chemical of Concern: ABM,ACP,AMZ,AZ,BFT,CBL,CPY,CYT,DMT,EFV,EPRN,FPP,FTT,FTTCl,FVL,MDT,MOM,MVP,Naled,PRN,TAUF,TCF,TDC

16. Bhinder, P. and Chaudhry, A. Evaluation of Toxic Potential of Acephate and Chlorpyrifos by Dominant Lethal Test on Culex quinquefasciatus. MOR,REP2013; 34, 573-577.
Rec #: 1920
Call Number: LITE EVAL CODED (ACP,CPY)
Notes: EcoReference No.: 165194
Chemical of Concern: ACP,CPY

17. Bird, J. P.; Melika, G.; Nicholls, J. A.; Stone, G. N., and Buss, E. A. Life History, Natural Enemies, and Management of Disholcaspis quercusvirens (Hymenoptera: Cynipidae) on Live Oak Trees. POP2013; 106, (4): 1747-1756.
Rec #: 1990
Call Number: LITE EVAL CODED (ACP,BFT,CBL)
Notes: EcoReference No.: 165484
Chemical of Concern: ACP,BFT,CBL

18. Branco, M. C. and Gatehouse, A. G. Insecticide Resistance in Plutella xylostella (L.) (Lepidoptera: Yponomeutidae) in the Federal District, Brazil. MOR1997; 26, (1): 75-79.
Rec #: 910
Call Number: LITE EVAL CODED (DM,MTM)
Notes: EcoReference No.: 63191
Chemical of Concern: DM,MTM

19. Brandenburg, R. L. and Royals, B. M. Controlling Fall Armyworm on Peanut, 1997. POP1998; 23, 251-(93F).
Rec #: 30
Call Number: LITE EVAL CODED (ACP,BFT,CYP,FPP,LCYT,MOM), PESTS (ACP,CYP,FPP,MOM), TARGET2012 (BFT,LCYT)
Notes: EcoReference No.: 150665
Chemical of Concern: ACP,BFT,CYP,FPP,LCYT,MOM

20. ---. Evaluating Thrips Control in Peanuts Using Percent Damage Leaflet Ratings, 1997. POP1998; 23, 252-(95F).
Rec #: 40
Call Number: LITE EVAL CODED (ACP,ADC,FPN,PRT)
Notes: EcoReference No.: 150664

Chemical of Concern: ACP,ADC,FPN,PRT

21. Brown, L. R. and Eads, C. O. Nantucket Pine Tip Moth in Southern California: Identity and Insecticidal Control. POP1975; 68, (3): 380-382.
Rec #: 990
Call Number: LITE EVAL CODED (ACP,CPY,DMT), OK (PSM), TARGET2012 (ADC,CBF,CBL,DS,DZ,MCB,MLN,OXD,TCF,TVP)
Notes: EcoReference No.: 114931
Chemical of Concern: ACP,ADC,CBF,CBL,CPY,DMT,DS,DZ,HCCH,MCB,MLN,MXC,OXD,PHSL,PPCP,PSM,TCF,TVP

22. Cameron, P. J.; Shelton, A. M.; Walker, G. P., and Tang, J. D. Comparative Insecticide Resistance of New Zealand and North American Populations of Diamondback Moth, Plutella xylostella (Lepidoptera : Plutellidae). MOR. P.J. Cameron, NZICFRL, Auckland, New Zealand//: 1997; 25, (2): 117-122.
Rec #: 50
Call Number: LITE EVAL CODED (LCYT,MOM,MTM,PMR)
Notes: EcoReference No.: 151184
Chemical of Concern: LCYT,MOM,MTM,PMR

23. Carmo, E. L.; Bueno, A. F., and Bueno, R. C. O. F. Pesticide Selectivity for the Insect Egg Parasitoid Telenomus remus. GRO,POP. [Bueno, AF] Embrapa Soybean, BR-86001970 Londrina, Parana, Brazil //: 2010; 55, (4): 455-464.
Rec #: 1720
Call Number: LITE EVAL CODED (ACP,AZX,BFT,CBD,CMZ,CPY,Conazoles,DFZ,DMDP,FMX,FTF,GCYH,GYP,GYPI,MFZ,MTC,PQT), NO MIXTURE (CYF,DU,IMC,NNCT)
Notes: EcoReference No.: 157409
Chemical of Concern: ACP,AZX,BFT,CBD,CMZ,CPY,CPZ,CYF,Conazoles,DFZ,DMDP,DU,ECZ,FMX,FTF,GCYH,GYP,GYPI,IMC,IZT,MFZ,MTC,NNCT,PQT,PRC,SS,TEZ,TFX,TPM

24. Chandler, L. D. Response of Liriomyza trifolii (Burgess) to Selected Insecticides with Notes on Hymenopterous Parasites. POP1985; 10, (3): 228-235.
Rec #: 1050
Call Number: LITE EVAL CODED (ACP,DMT,MTM), OK (CYP,CYR,FNV,FVL,PMR), TARGET MANUAL (OML)
Notes: EcoReference No.: 96099
Chemical of Concern: ABM,ACP,CYP,CYR,DMT,FNV,FVL,MTM,OML,PMR

25. Cheng, H. H. and Hanlon, J. J. Control of Several Early-Season Insects of Flue-Cured Tobacco with Acephate in the Transplant Water. BCM,BEH,MOR,POP1986; 30, 104-108.
Rec #: 60
Call Number: LITE EVAL CODED (ACP,DM), NO EFFECT (DDMITC), OK (CYP,PMR)
Notes: EcoReference No.: 150661
Chemical of Concern: ACP,CYP,DDMITC,DM,HCCH,PEB,PMR,PPCP

26. Chu, C. C.; Henneberry, T. J., and Akey, D. H. Insecticide Control of Sweetpotato Whitefly on Spring Cantaloupe, 1992. POP1994; 19, 78-79 (29E).
Rec #: 900
Call Number: LITE EVAL CODED (AMZ,BFT,ES,FPP,FSTAL,FYC,IMC,MPEDE,MSO,MTM,NNCT)
Notes: EcoReference No.: 97787
Chemical of Concern: AMZ,BFT,BPZ,ES,FPP,FSTAL,FYC,IMC,MPEDE,MSO,MTM

27. Costello, R. W. and Leonard, B. R. Evaluation of Foliar Insecticides Against Thrips on Seedling Cotton,

1998. PHY,POP1999; 24, 242-243 (F56).
Rec #: 720
Call Number: LITE EVAL CODED (ACP,CBF,DCTP,DMT,FPN,IMC,LCYT,NNCT,OML)
Notes: EcoReference No.: 88060
Chemical of Concern: ACP,CBF,DCTP,DMT,FPN,IMC,LCYT,OML

28. Crowe, B. D.; McPherson, R. M., and Taylor, J. D. Aphid and Thrips Control in Georgia Flue-Cured Tobacco, 1994. POP1996; 21, 302-303 (142F).
Rec #: 70
Call Number: LITE EVAL CODED (ACP,MOM), NO EFFECT (MLX), NO MIXTURE (MPEDE), OK (IMC,NNCT)
Notes: EcoReference No.: 151447
Chemical of Concern: ACP,IMC,MLX,MOM,MPEDE,NNCT,NPP,PEB,PMZ

29. Crowe, B. D.; Taylor, J. D., and McPherson, R. M. Control of Stink Bugs, Velvetbean Caterpillars, and Threecornered Alfalfa Hoppers on Soybeans, 1995. POP1997; 22, 311-312 (124F).
Rec #: 1260
Call Number: LITE EVAL CODED (ACP,TLM), OK (CBL,DFZ)
Notes: EcoReference No.: 153378
Chemical of Concern: ACP,CBL,DFZ,TLM

30. De Castro, A. A.; Correa, A. S.; Legaspi, J. C.; Guedes, R. N. C.; Serrao, J. E., and Zanuncio, J. C. Survival and Behavior of the Insecticide-Exposed Predators Podisus nigrispinus and Supputius cincticeps (Heteroptera: Pentatomidae). BEH,MOR. anciagro@gmail.com//: 2013; 93, (6): 1043-1050.
Rec #: 1930
Call Number: LITE EVAL CODED (MTM), TARGET2012 (DM)
Notes: EcoReference No.: 165251
Chemical of Concern: DM,MTM,SS

31. Deng, L.; Dai, J.; Cao, H., and Xu, M. Effects of Methamidophos on the Predating Behavior of Hylyphantes graminicola (Sundevall) (Araneae: Linyphiidae). BEH2007; 26, (3): 478-482.
Rec #: 640
Call Number: LITE EVAL CODED (MTM)
Notes: EcoReference No.: 95999
Chemical of Concern: MTM

32. Doane, C. C. and Dunbar, D. M. Field Evaluation of Insecticides Against the Gypsy Moth and Repellent Action of Chlordimeform. BEH,MOR,POP1973; 66, (5): 1187-1189.
Rec #: 750
Call Number: LITE EVAL CODED (ACP), TARGET2012 (CBL)
Notes: EcoReference No.: 114797
Chemical of Concern: ACP,CBL,PHSL

33. Doss, M. and Pinkston, K. Bagworm Control on Eastern Red Cedar, 1992. PHY,POP1993; 18, 347-(2H).
Rec #: 1230
Call Number: LITE EVAL CODED (ACP,CPY,TUZ)
Notes: EcoReference No.: 153372
Chemical of Concern: ACP,CPY,TUZ

34. Drescher, W. and Geusen-Pfister, H. Comparative Testing of the Oral Toxicity of Acephate, Dimethoate and Methomyl to Honeybees, Bumblebees and Syrphidae. MOR1991; 288, 133-138.
Rec #: 380
Call Number: LITE EVAL CODED (ACP,DMT,MOM)
Notes: EcoReference No.: 79727
Chemical of Concern: ACP,DMT,MOM

35. Edelson, J. V. and Peters, M. Evaluation of Insecticide Efficacy and Yield Response in Peppers, 1996. POP1997; 22, 148 (75E).
Rec #: 1250
Call Number: LITE EVAL CODED (ACP,IMC,LCYT,NNCT)
Notes: EcoReference No.: 153376
Chemical of Concern: ACP,IMC,LCYT

36. Edelson, J. V.; Royer, T. A., and Cartwright, B. Control of Arthropod Pests on Cantaloupe, 1986. GRO,POP1987; 12, 108-109 (116).
Rec #: 420
Call Number: EFFICACY (DZ,MOM), LITE EVAL CODED (DMT,FNV,MLN,MTM), OK (AZ,DCF,ES,MVP,Naled,OML,OXD), TARGET MANUAL (DZ,MOM), TARGET2012 (CBL)
Notes: EcoReference No.: 88727
Chemical of Concern: AZ,CBL,DCF,DMT,DZ,EPRN,ES,ETN,FNV,MLN,MOM,MTM,MVP,Naled,OML,OXD,PPHD,PRN

37. El-Banhawy, E. M. and Abou-Awad, B. A. Toxicity of the Organophosphate, Methamidophos and Pyrethroid, Cypermethrin, and the Systemic Fungicide, Fenarimol to Adult and Egg Stages of the Datura Mite, Eriophyes datura (Acari: Eriophyidae). MOR,REP1984; 14, 199-206.
Rec #: 1200
Call Number: LITE EVAL CODED (CYP,FRM,MTM), TARGET2012 (CYP)
Notes: EcoReference No.: 99787
Chemical of Concern: CYP,FRM,MTM

38. Eulitz, E. G. Initial Experiments in the Control of False Wireworm (Tenebrionidae) on Tobacco Transplants. MOR,POP1986; 18, (3): 115-119.
Rec #: 850
Call Number: LITE EVAL CODED (ACP,ADC,CPY,MOM,PRT), OK (CBF,CYP,ES), TARGET2012 (CBL,DZ,TCF,TVP)
Notes: EcoReference No.: 74106
Chemical of Concern: ACP,ADC,CBF,CBL,CPY,CYP,DZ,ES,MOM,PRT,TCF,TVP

39. Faircloth, J. C.; Bradley, J. R. Jr., and Van Duyn, J. W. Effect of Insecticide Treatments and Environmental Factors on Thrips Populations, Plant Growth and Yield of Cotton. GRO,POP2002; 37, (4): 308-316.
Rec #: 570
Call Number: EFFICACY (ADC), LITE EVAL CODED (ACP), OK (IMC,NNCT)
Notes: EcoReference No.: 109816
Chemical of Concern: ACP,ADC,IMC,NNCT

40. Farag, A. T.; Radwan, A. H.; Eweidah, M. H.; ElMazoudy, R. H., and El-Sebae, A. E. K. Evaluation of Male-Mediated Reproductive Toxic Effects of Methamidophos in the Mouse. BCM,BEH,CEL,GRO,MOR,REP. aminafarag2002@yahoo.com//Department of Pesticide Chemistry and Toxicology, Alexandria University, Alexandria, Egypt//: 2012; 44, (2): 116-124.
Rec #: 1800
Call Number: LITE EVAL CODED (MTM)
Notes: EcoReference No.: 161033
Chemical of Concern: MTM

41. Fife, J. H.; Leonard, B. R., and Costello, R. W. Efficacy of Selected Insecticides Against Cotton Aphids in Cotton, 1998. POP1999; 24, 243-244 (F57).
Rec #: 690
Call Number: LITE EVAL CODED (CBF,CYF,DCTP,ES,IMC,MOM,MTM,NNCT)
Notes: EcoReference No.: 88074
Chemical of Concern: CBF,CYF,DCTP,ES,IMC,MOM,MTM

42. Fitzpatrick, G.; Cherry, R. H., and Dowell, R. V. Short-Term Effects of Three Insecticides on Predators and Parasites of the Citrus Blackfly. GRO,POP1978; 7, 553-555.
Rec #: 1070
Call Number: LITE EVAL CODED (ACP), OK (MDT,MLN)
Notes: EcoReference No.: 36622
Chemical of Concern: ACP,MDT,MLN

43. Foudoulakis, M.; Balaskas, C.; Csato, A.; Szentes, C., and Arapis, G. Japanese Quail Acute Exposure to Methamidophos: Experimental Design, Lethal, Sub-Lethal Effects and Cholinesterase Biochemical and Histochemical Expression. BCM,BEH,CEL,GRO,MOR,NOC2013; 450/451, 334-347.
Rec #: 1970
Call Number: LITE EVAL CODED (MTM)
Notes: EcoReference No.: 165252
Chemical of Concern: MTM

44. Frank, S. D. Reduced Risk Insecticides to Control Scale Insects and Protect Natural Enemies in the Production and Maintenance of Urban Landscape Plants. MOR,POP2012; 41, (2): 377-386.
Rec #: 1950
Call Number: LITE EVAL CODED (ACP), OK (BFT)
Notes: EcoReference No.: 165298
Chemical of Concern: ACP,ACT,BFT,BPZ,DNF,NNCT,PYX,TMX

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Rec #: 1760
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 165235
Chemical of Concern: ACP

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Rec #: 1710
Call Number: LITE EVAL CODED (ACP,CYP)
Notes: EcoReference No.: 160053
Chemical of Concern: ACP,CYP

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Rec #: 1340
Call Number: LITE EVAL CODED (ACP,CPY), TARGET MANUAL (CBL,DZ,FPN,IMC,NNCT)
Notes: EcoReference No.: 153504
Chemical of Concern: ACP,CBL,CPY,DZ,FPN,IMC,IZF,NNCT

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Rec #: 1210
Call Number: LITE EVAL CODED (ACP,MTM), TARGET2012 (DMT,IMC,NNCT)
Notes: EcoReference No.: 91947
Chemical of Concern: ACP,DMT,IMC,MTM,NNCT,SS,TAP

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Rec #: 1330
Call Number: LITE EVAL CODED (CYF,CYH,CYP,DM,MP,MTM), PESTS (CYP),

TARGET2012 (CYF,CYH,DM,MP)
Notes: EcoReference No.: 156088
Chemical of Concern: CYF,CYH,CYP,DM,MP,MTM

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Rec #: 1020
Call Number: LITE EVAL CODED (ACP,ADC,CBL,DMT,DS,EFV,LCYT,PRT)
Notes: EcoReference No.: 105803
Chemical of Concern: ACP,ADC,CBL,DMT,DS,EFV,LCYT,PRT

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Rec #: 1850
Call Number: LITE EVAL CODED (MTM)
Notes: EcoReference No.: 165258
Chemical of Concern: MTM

52. Hao, D. F.; Xu, W.; Wang, H.; Du, L. F.; Yang, J. D.; Zhao, X. J., and Sun, C. H. Metabolomic Analysis of the Toxic Effect of Chronic Low-Dose Exposure to Acephate on Rats Using Ultra-Performance Liquid Chromatography/Mass Spectrometry. BCM,BEH,CEL,GRO2012; 83, 25-33.
Rec #: 1870
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 165237
Chemical of Concern: ACP

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Rec #: 410
Call Number: LITE EVAL CODED (ADC,AZ,CBF,CBL,ES,MLN,MTM,OML,PMR,PSM), PESTS (ADC,CBF,ES,MTM,PMR), TARGET2012 (AZ,CBL,MLN,OML,PSM)
Notes: EcoReference No.: 113739
Chemical of Concern: ADC,AZ,CBF,CBL,ES,MLN,MTM,OML,PMR,PSM

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Rec #: 1280
Call Number: LITE EVAL CODED (ACP,FPP)
Notes: EcoReference No.: 153468
Chemical of Concern: ACP,FPP

55. Heller, P. R. and Kellogg, S. Pine Needle Scale Control on Scotch Pine in Centre County, Pennsylvania, 1987. PHY,POP1988; 13, 382-(22H).
Rec #: 1010
Call Number: LITE EVAL CODED (ACP,CBL,CPY,CYF,DZ,EFV,KSP,TAUF)
Notes: EcoReference No.: 88821
Chemical of Concern: ACP,CBL,CPY,CYF,DZ,EFV,IFP,KSP,TAUF

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Rec #: 460
Call Number: LITE EVAL CODED (ACP,CBL,CPY,DZ,FPP,PMR,PPX,TAUF), TARGET2012 (CYF,TCF)
Notes: EcoReference No.: 88815
Chemical of Concern: ACP,BDC,CBL,CPY,CYF,DZ,FPP,IFP,IZF,PMR,PPX,TAUF,TCF

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of the Spruce Budmoth, Zeiraphera canadensis Mut. and Free. (Lepidoptera: Tortricidae): Laboratory and Field Studies. MOR,POP1989; 121, (1): 81-91.
Rec #: 1170
Call Number: LITE EVAL CODED (ACP,AZ,CPY,FNT,MOM,PMR,TDC), NO ENDPOINT (TCF), TARGET2012 (TCF)
Notes: EcoReference No.: 73595
Chemical of Concern: ACP,AZ,CPY,FNT,MOM,PMR,SPS,TCF,TDC

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Rec #: 440
Call Number: LITE EVAL CODED (ACP,FAZ,NMO), OK (AZD,DMT,IMC,NML,NNCT)
Notes: EcoReference No.: 75422
Chemical of Concern: ACP,AZD,DMT,FAZ,IMC,NML,NMO,NNCT

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Rec #: 370
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 69718
Chemical of Concern: ACP,MOM,SS

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Rec #: 980
Call Number: LITE EVAL CODED (ACP,DMT,FNV,MOM), TARGET2012 (CBL,DFZ)
Notes: EcoReference No.: 112694
Chemical of Concern: ACP,CBL,DEM,DFZ,DMT,FNV,MOM

61. Hirashima, A.; Takeya, R.; Taniguchi, E., and Eto, M. Metamorphosis, Activity of Juvenile-Hormone Esterase and Alteration of Ecdysteroid Titres: Effects of Larval Density and Various Stress on the Red Flour Beetle, Tribolium freemani Hinton (Coleoptera: Tenebrionidae). BCM,GRO1995; 41, (5): 383-388.
Rec #: 1380
Call Number: LITE EVAL CODED (MTM), OK (PPB)
Notes: EcoReference No.: 153345
Chemical of Concern: MTM,PPB

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Rec #: 740
Call Number: LITE EVAL CODED (ACP,ALSV,ATZ,CBL,DMB,DMDP,DMT,DZ,GYPI,MLN,MOM,Naled,PMR,PPN,PQT,PRO,PSM,TFN,TMP)
Notes: EcoReference No.: 35249
Chemical of Concern: ACP,ALSV,ATZ,CBL,DFPM,DMB,DMDP,DMT,DZ,EN,EPRN,GYPI,HCCH,MLN,MOM,Naled,PCLK,PMR,PPCP,PPN,PQT,PRN,PRO,PSM,SPS,TFN,TMP,TXP

63. Johnson, D. R. and Studebaker, G. Control of Bollworm and Budworm in Cotton Using Insecticide Combinations in South-Central Arkansas, 1990. POP1993; 18, 231-232 (57F).
Rec #: 80
Call Number: LITE EVAL CODED (ACP,CYF,LCYT,TDC,TLM), NO MIXTURE (AMZ,CYP,EFV,ES,MOM,PFF,PPB)

Notes: EcoReference No.: 150733
Chemical of Concern: ACP,AMZ,CYF,CYP,EFV,ES,LCYT,MOM,PFF,PPB,SPS,TDC,TLM

64. ---. Control of Bollworm on Cotton Using BT Combinations, 1991. POP1993; 18, 235-236 (62F).
Rec #: 430
Call Number: LITE EVAL CODED (ACP,CYF,ES,TDC), NO MIXTURE (MOM,PPB), OK (AMZ,PFF,TLM)
Notes: EcoReference No.: 92325
Chemical of Concern: ACP,AMZ,CYF,ES,MOM,PFF,PPB,SPS,TDC,TLM

65. ---. Control of Thrips in Cotton with In-Furrow Insecticides, 1990. GRO,POP1993; 18, 229-230 (54F).
Rec #: 90
Call Number: LITE EVAL CODED (ACP,ADC,DS,PRT,TDC)
Notes: EcoReference No.: 150473
Chemical of Concern: ACP,ADC,DS,PRT,TDC

66. Johnson, D. R.; Studebaker, G., and Kimbrough, J. Control of Thrips in Cotton with In-Furrow Insecticides, 1991. GRO,POP1993; 18, 230-(55F).
Rec #: 100
Call Number: LITE EVAL CODED (ACP,ADC,DCTP,DS,PRT,TBO)
Notes: EcoReference No.: 150470
Chemical of Concern: ACP,ADC,DCTP,DS,PRT,TBO

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Rec #: 110
Call Number: LITE EVAL CODED (ACP,CPY,DMT,DZ,ES,PMR)
Notes: EcoReference No.: 153472
Chemical of Concern: ACP,CPY,DMT,DZ,ES,PMR

68. Kanga, L. H. B. and Somorin, A. B. Susceptibility of the Small Hive Beetle, Aethina tumida (Coleoptera: Nitidulidae), to Insecticides and Insect Growth Regulators. MOR2012; 43, (1): 95-102.
Rec #: 1820
Call Number: LITE EVAL CODED (CPY,MOM,MTM,OML,TUZ), OK (CYP,CYR,ES,FVL,PPX,PSM), TARGET2012 (CMPH,DZ,FNT,FYC,MLN,MTPN)
Notes: EcoReference No.: 160168
Chemical of Concern: CMPH,CPY,CYP,CYR,DZ,EPRN,ES,FNT,FVL,FYC,MLN,MOM,MTM,MTPN,OML,PPX,PRN,PSM,TUZ

69. Kao, S. S. and Tzeng, C. C. Toxicity of Insecticides to Cotesia plutellae, a Parasitoid of Diamondback Moth. GRO,MOR,REP1992; 32, 287-296.
Rec #: 120
Call Number: LITE EVAL CODED (ACP,CBF,DM,FNV,MOM,MTM,MVP,PMR)
Notes: EcoReference No.: 153492
Chemical of Concern: ACP,CBF,DM,FNV,MOM,MTM,MVP,PMR

70. Kay, I. R. and Brown, J. D. Insecticidal Control of Eggfruit Caterpillar Sceliodes cordalis (Doubleday) (Lepidoptera: Pyralidae) in Eggplant. POP1992; 7, (3): 100-101.
Rec #: 130
Call Number: LITE EVAL CODED (DZ,FVL,MOM,MTM), OK (EFV,ES,MDT,MVP,TDC)
Notes: EcoReference No.: 159504
Chemical of Concern: DZ,EFV,ES,FNTH,FVL,MDT,MOM,MTM,MVP,SPS,TDC

71. Kinzer, H. G. and Reeves, J. M. Chemical Treatments for Brood Control and Suppression of Dendroctonus adjunctus Attacks on Ponderosa Pine. POP,REP1985; 10, (4): 244-252.

Rec #: 140
Call Number: LITE EVAL CODED (ACP,CPY,CPYM), OK (CBF,ES), TARGET2012 (CBL)
Notes: EcoReference No.: 153325
Chemical of Concern: ACP,CBF,CBL,CPY,CPYM,ES,HCCH,PPCP

72. Kumar, J. and Sharma, S. D. Efficacy and Economics of Bacillus thuringiensis var Kurstaki for Management of Helicoverpa armigera on Tomato (Lycopersicon esculentum) in Lower Kullu Valley, Himachal Pradesh. POP2004; 74, (7): 396-398.
Rec #: 1660
Call Number: LITE EVAL CODED (ACP,ES,LCYT), NO MIXTURE (AZD), TARGET (AZD)
Notes: EcoReference No.: 155375
Chemical of Concern: ACP,AZD,ES,LCYT

73. Lampert, E. P. Control of Tobacco Wireworms with Soil and Transplant Water Insecticides, 1985. POP1986; 11, 364-365 (455).
Rec #: 530
Call Number: LITE EVAL CODED (ACP,EP,TDC), OK (ADC,FPN)
Notes: EcoReference No.: 88762
Chemical of Concern: ACP,ADC,EP,FPN,TDC

74. Lampert, E. P. and Stephenson, A. S. Control of Tobacco Budworms with Foliar Insecticides, 1991. PHY,POP1992; 17, 292-293 (139F).
Rec #: 1290
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 153491
Chemical of Concern: ACP

75. Larson, L. L. The Selective Toxicity of Orthene. ACC,BCM,GRO,MOR,PHY,REP1975: 296 p. (UMI#76-12-654).
Rec #: 1090
Call Number: LITE EVAL CODED (ACP,MTM), NO MIXTURE (PPB)
Notes: EcoReference No.: 88764
Chemical of Concern: ACP,MTM,PPB

76. Leonard, B. R. and Graves, J. B. Evaluation of Ovasyn Mixtures Against Tobacco Budworm and Bollworm, 1990. POP1991; 16, 190-(81F).
Rec #: 1270
Call Number: LITE EVAL CODED (ACP,LCYT,TDC), NO MIXTURE (AMZ), TARGET (AMZ)
Notes: EcoReference No.: 153465
Chemical of Concern: ACP,AMZ,LCYT,TDC

77. Lima, C. S.; Nunes-Freitas, A. L.; Ribeiro-Carvalho, A.; Filgueiras, C. C.; Manhaes, A. C.; Meyer, A., and Abreu-Villaca, Y. Exposure to Methamidophos at Adulthood Adversely Affects Serotonergic Biomarkers in the Mouse Brain. BCM2011; 32, (6): 718-724.
Rec #: 1960
Call Number: LITE EVAL CODED (MTM)
Notes: EcoReference No.: 165253
Chemical of Concern: MTM

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Rec #: 1890
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 163150
Chemical of Concern: ACP

79. Mani, M. and Krishnamoorthy, A. Response of the Encyrtid Parasitoid, Tetracnemoidea indica of the Oriental Mealybug Planococcus lilacinus to Different Pesticides. MOR1996; 24, (1/2): 80-85.
Rec #: 1060
Call Number: LITE EVAL CODED (ACP,CBL,CPY,CTN,CYP,Captan,Conazoles,DCF,DDVP,DM,DMT,ES,FNV,FSTAL,MLN,MMM,MP,OXD,SFR,TAUF,TDF,Ziram)
Notes: EcoReference No.: 67219
Chemical of Concern: ACP,CBL,CPY,CTN,CYP,Captan,Conazoles,DCF,DDVP,DINO,DM,DMT,ES,FNTH,FNV,FSTAL,MLN,MMM,MP,OXD,PHSL,PPHD,SFR,TAUF,TDF,TPM,Zineb,Ziram

80. Mani, M.; Krishnamoorthy, A., and Rao, M. S. Toxicity of Different Pesticides to the Exotic Parasitoid Leptomastix dactylopii How. MOR1993; 21, (1): 98-99.
Rec #: 150
Call Number: LITE EVAL CODED (ACP,CBL,CPY,CYP,DDVP,DM,DMT,ES,FNV,MLN,MP,TAUF)
Notes: EcoReference No.: 157573
Chemical of Concern: ACP,CBL,CPY,CYP,DDVP,DM,DMT,ES,FNTH,FNV,MLN,MP,PHSL,PPHD,TAUF

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Rec #: 600
Call Number: LITE EVAL CODED (MTM,Maneb,PPX), OK (AZ,DCF,FTT,NMO,PHMD,TCF)
Notes: EcoReference No.: 89465
Chemical of Concern: AZ,Conazoles,DCF,DINO,FTT,MTM,Maneb,NMO,PHMD,PIM,PPX,TCF

82. McCalley, N. F. and Wang, D. I. Field Evaluation of Insecticides for Control of the Green Peach Aphid and Alfalfa Looper on Head Lettuce. POP1972; 65, (3): 794-796.
Rec #: 760
Call Number: LITE EVAL CODED (MOM,MTM), OK (PSM), TARGET2012 (OXD)
Notes: EcoReference No.: 112784
Chemical of Concern: MOM,MTM,OXD,PHSL,PSM

83. McClure, M. S. Effects of Implanted and Injected Pesticides and Fertilizers on the Survival of Adelges tsugae (Homoptera: Adelgidae) and on the Growth of Tsuga canadensis. GRO. Conn. Agric. Exp. Stn.,Val. Lab.,Windsor,CT////: 1992; 85, (2): 468-472.
Rec #: 620
Call Number: LITE EVAL CODED (ACP), NO EXP TYPE (DCTP,OXD)
Notes: EcoReference No.: 101482
Chemical of Concern: ACP,DCTP,OXD

84. McCutcheon, G. S.; Turnipseed, S. G., and Sullivan, M. J. Parasitization of Lepidopterans as Affected by Nematicide-Insecticide Use in Soybean. POP1990; 83, (3): 1002-1007.
Rec #: 1000
Call Number: LITE EVAL CODED (ACP,ADC,CBF,FMP)
Notes: EcoReference No.: 113460
Chemical of Concern: ACP,ADC,CBF,FMP

85. McDonald, S. Evaluation of Organophosphorus and Pyrethroid Insecticides for Control of the Pale Western Cutworm. MOR1981; 74, (1): 45-48.
Rec #: 1220
Call Number: LITE EVAL CODED (CPY,FNV,FPP,MTM), OK (CYP,PMR), TARGET2012 (DM,PFF,TVP)
Notes: EcoReference No.: 153533
Chemical of Concern: CPY,CYP,DM,EN,FNV,FPP,FYT,MTM,PFF,PMR,TVP

86. McPherson, R. M.; Crowe, B. D., and Taylor, J. D. Tobacco Budworm and Hornworm Control in Flue-Cured Tobacco, 1996. POP1997; 22, 327-(141F).
Rec #: 190
Call Number: LITE EVAL CODED (ACP,MOM), NO EFFECT (FMP,MLX), TARGET2012 (FAZ)
Notes: EcoReference No.: 153480
Chemical of Concern: ACP,FAZ,FMP,MLX,MOM,NPP,PEB,SS

87. McPherson, R. M. and Lambert, A. L. Control of Hornworms in Georgia Flue-Cured Tobacco, 1993. POP1994; 19, 283-284 (146F).
Rec #: 470
Call Number: LITE EVAL CODED (ACP,LCYT)
Notes: EcoReference No.: 101869
Chemical of Concern: ACP,LCYT

88. McPherson, R. M.; Mintarsih, T., and Donohue, J. Late Season Tobacco Budworm and Tobacco Hornworm Control on Flue-Cured Tobacco, 1990. POP1991; 16, 235-(137F).
Rec #: 160
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 153476
Chemical of Concern: ACP,MOM

89. McPherson, R. M.; Mintarsih, T. H., and Padgett, M. L. Aphid Control in Georgia Flue-Cured Tobacco, 1991. POP1992; 17, 294-(141F).
Rec #: 340
Call Number: LITE EVAL CODED (ACP), NO MIXTURE (CPY,FMP,MLX,MPEDE), OK (ES)
Notes: EcoReference No.: 104692
Chemical of Concern: ABM,ACP,CPY,ES,FMP,MLX,MPEDE,NPP,PEB

90. McPherson, R. M.; Mintarsih, T. H., and Taylor, J. D. Stink Bug Control in Soybean, 1991. POP1992; 17, 266-267 (109F).
Rec #: 180
Call Number: LITE EVAL CODED (ACP,MP,TLM), NO MIXTURE (MPEDE)
Notes: EcoReference No.: 121447
Chemical of Concern: ACP,MP,MPEDE,TLM

91. McPherson, R. M. and Padgett, M. Tobacco Budworm and Tobacco Hornworm Control on Flue-Cured Tobacco with Foliar Insecticides, 1987. PHY,POP1988; 13, 310-311 (179F).
Rec #: 1100
Call Number: LITE EVAL CODED (ACP,CBL,EFV,LCYT)
Notes: EcoReference No.: 88861
Chemical of Concern: ACP,CBL,EFV,LCYT

92. McPherson, R. M.; Padgett, M. L., and Taylor, J. D. Budworm and Hornworm Control in Tobacco, 1991. POP1992; 17, 296-297 (143F).
Rec #: 170
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 153478
Chemical of Concern: ACP,MOM

93. McPherson, R. M.; Padgett, M. L.; Taylor, J. D., and Lambert, A. L. Controlling Aphids in Georgia Flue-Cured Tobacco with Foliar Insecticides, 1993. POP1994; 19, 283-(145F).
Rec #: 540
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 106298
Chemical of Concern: ACP,MOM,PMZ

94. McPherson, R. M.; Seagraves, M. P.; Ottens, R. J., and Bundy, C. S. Leaf Dip Bioassay to Determine Susceptibility of Tobacco Hornworm (Lepidoptera: Sphingidae) to Acephate, Methomyl and Spinosad. BEH,MOR2003; 38, (2): 262-268.
Rec #: 960
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 72750
Chemical of Concern: ACP,MOM,SS

95. McPherson, R. M.; Taylor, J. D., and Crowe, B. D. Late Season Control of Hornworms in GA Flue-Cured Tobacco, 1994. POP1996; 21, 305-(145F).
Rec #: 1360
Call Number: LITE EVAL CODED (ACP,CBL,LCYT)
Notes: EcoReference No.: 153463
Chemical of Concern: ACP,CBL,LCYT

96. McPherson, R. M.; Taylor, J. D., and Wells, M. L. Tobacco Budworm Control on Flue-Cured Tobacco, 1998. POP1999; 24, 306-307 (F126).
Rec #: 1310
Call Number: LITE EVAL CODED (ACP,LCYT), NO EFFECT (FMP)
Notes: EcoReference No.: 153481
Chemical of Concern: ACP,FMP,LCYT,NPP,PEB,SS

97. Micinski, S.; Fitzpatrick, B. J.; Forrester, F. D., and Graves, J. B. Late-Season Control of the Bollworm-Tobacco Budworm Complex in Cotton, 1993. POP1994; 19, 234 (79F).
Rec #: 1240
Call Number: LITE EVAL CODED (ACP,CYF,DM,LCYT,TDC), TARGET (CFP,PFF)
Notes: EcoReference No.: 153367
Chemical of Concern: ACP,CFP,CYF,DM,LCYT,PFF,SPS,TDC

98. Micinski, S.; Kirby, M. L., and Graves, J. B. Efficacy of Selected Insecticides for Plant Bug Control, 1990. POP1991; 16, 197-198 (89F).
Rec #: 700
Call Number: LITE EVAL CODED (ACP,CPY,DMT,MLN,MTM,OML,PFF,TDC), OK (AZ,DS)
Notes: EcoReference No.: 90646
Chemical of Concern: ACP,AZ,CPY,DMT,DS,MLN,MTM,OML,PFF,SPS,TDC

99. ---. Late-Season Control of the Bollworm-Tobacco Budworm Complex, 1990. POP1991; 16, 196-(88F).
Rec #: 950
Call Number: LITE EVAL CODED (ACP,LCYT,PFF,TDC), NO MIXTURE (AMZ), TARGET2012 (AMZ)
Notes: EcoReference No.: 90711
Chemical of Concern: ACP,AMZ,LCYT,PFF,SPS,TDC

100. Micinski, S.; Scarborough, R. G.; Forrester, F. D., and Graves, J. B. Efficacy of Selected Insecticide Mixtures for Bollworm and Tobacco Budworm Control, 1997. POP1998; 23, 239-241 (79F).
Rec #: 200
Call Number: LITE EVAL CODED (ACP,LCYT), NO EFFECT (ADC,IMC,NNCT,OML), NO MIXTURE (CYF,PSM,TDC), OK (PFF)
Notes: EcoReference No.: 150748
Chemical of Concern: ACP,ADC,CYF,IMC,LCYT,NNCT,OML,PFF,PSM,SS,TDC

101. Miller, F. and Uetz, S. Evaluating Biorational Pesticides for Controlling Arthropod Pests and Their Phytotoxic Effects on Greenhouse Crops. GRO,PHY,POP. F. Miller, Urban IPM, University of Illinois, Countryside Extension Center, Countryside, IL 60525, United States//: 1998; 8, (2): 185-192.
Rec #: 710

Call Number: LITE EVAL CODED (ACP,ALSV,AZD,BFT,FPP,MOIL,MPEDE,MSO,TAUF)
Notes: EcoReference No.: 62944
Chemical of Concern: ABM,ACP,ALSV,AZD,BFT,DIE,FPP,FVL,MOIL,MPEDE,MSO

102. Mizell III, R. F. and Schiffhauer, D. E. Control of Glyphidocera juniperella Adamski in Container-Grown Juniper, 1984. POP1986; 11, 411-(539).
Rec #: 450
Call Number: LITE EVAL CODED (ACP,MOM), OK (CPY,CYP,TAUF), TARGET2012 (ADC,AZ,CBL,DS,DZ,MLN,OXD)
Notes: EcoReference No.: 88035
Chemical of Concern: ACP,ADC,AZ,CBL,CPY,CYP,DS,DZ,IZF,MLN,MOM,OXD,TAUF

103. Mori, K. and Gotoh, T. Effects of Pesticides on the Spider Mite Predators, Scolothrips takahashii (Thysanoptera: Thripidae) and Stethorus japonicus (Coleoptera: Coccinellidae). MOR. gotoh@msv.ipc.ibaraki.ac.jp//: 2001; 27, (4): 299-302.
Rec #: 660
Call Number: LITE EVAL CODED (ACP), TARGET2012 (CFP,IMC,NNCT)
Notes: EcoReference No.: 69742
Chemical of Concern: ACP,ACQ,ACT,BFZ,BPZ,CFP,EMMB,EXZ,IMC,LUF,NNCT,PMZ,SS

104. Muruvanda, D. A.; Beardsley, J. W., and Mitchell, W. C. Insecticidal Control of Sweet Potato Weevils (Coleoptera: Curculionidae) in Hawaii. POP1986; 63, (2): 155-157.
Rec #: 210
Call Number: LITE EVAL CODED (ACP,PMR), OK (CBF,ES,MP), TARGET2012 (CBL)
Notes: EcoReference No.: 121361
Chemical of Concern: ACP,CBF,CBL,ES,MP,PMR

105. Nault, B. A. and Speese III, J. Evaluation of Foliar Products for Controlling Insect Pests of Snap Beans, 1998. POP1999; 24, 97-98 (E2).
Rec #: 1320
Call Number: LITE EVAL CODED (ACP,BFT)
Notes: EcoReference No.: 153489
Chemical of Concern: ACP,BFT

106. Nielsen, D. G. and Boggs, J. F. Topical Toxicity of Insecticides to First-Instar Black Vine Weevil (Coleoptera: Curculionidae). MOR1985; 78, (5): 1114-1117.
Rec #: 1140
Call Number: LITE EVAL CODED (ACP,ADC,AZ,CBF,CPY,DZ,FNV,OML,TBO), PESTS (ADC,CBF,CPY,FNV), TARGET2012 (AZ,DZ,OML,TBO)
Notes: EcoReference No.: 112759
Chemical of Concern: ACP,ADC,AZ,BDC,CBF,CPY,DZ,FNV,IFP,IZF,OML,TBO

107. Noetzel, D.; Ricard, M., and Sheets, B. Foliar Insect Control in Lupine, 1990. GRO,POP1992; 17, 347-(57G).
Rec #: 770
Call Number: EFFICACY (ES,LCYT,PRT), LITE EVAL CODED (ACP), NO MIXTURE (CBL,EFV), OK (CBF)
Notes: EcoReference No.: 79348
Chemical of Concern: ACP,CBF,CBL,EFV,ES,LCYT,PRT

108. Noetzel, D. M. and Miller, J. Systemic vs Foliar Control of Colorado Potato Beetle, 1993. POP1994; 19, 114 (73E).
Rec #: 220
Call Number: LITE EVAL CODED (EFV,LCYT,MTM,PRT), OK (CBF,CYP,ES,IMC,NNCT)
Notes: EcoReference No.: 153490
Chemical of Concern: CBF,CYP,EFV,ES,IMC,LCYT,MTM,NNCT,PRT

109. Obrycki, J. J.; Tauber, M. J., and Tingey, W. M. Comparative Toxicity of Pesticides to Edovum puttieri (Hymenoptera: Eulophidae), an Egg Parasitoid of the Colorado Potato Beetle (Coleoptera: Chrysomelidae). GRO,MOR1986; 79, (4): 948-951.
Rec #: 390
Call Number: LITE EVAL CODED (MTM), NO MIXTURE (FNV,PPB,RTN)
Notes: EcoReference No.: 109954
Chemical of Concern: CYT,FNV,MTM,PPB,RTN,TPTH

110. Oliver, J. B.; Fare, D. C.; Youssef, N.; Scholl, S. S.; Reding, M. E.; Ranger, C. M.; Moyseenko, J. J., and Halcomb, M. A. Evaluation of a Single Application of Neonicotinoid and Multi-Application Contact Insecticides for Flatheaded Borer Management in Field Grown Red Maple Cultivars. GRO,POP2010; 28, (3): 135-149.
Rec #: 1690
Call Number: LITE EVAL CODED (ACP,CPY), OK (BFT,IMC,NNCT)
Notes: EcoReference No.: 156579
Chemical of Concern: ACP,BFT,CPY,DNF,IMC,KRSM,NNCT,TMX

111. Olofinboba, M. O. and Kozlowski, T. T. Effects of Three Systemic Insecticides on Seed Germination and Growth of Pinus halepensis Seedlings. GRO,PHY,REP1982; 64, 255-258.
Rec #: 590
Call Number: LITE EVAL CODED (ACP,CPY,OML)
Notes: EcoReference No.: 41343
Chemical of Concern: ACP,CPY,OML

112. Osterberg, J. S.; Darnell, K. M.; Blickley, T. M.; Romano, J. A., and Rittschof, D. Acute Toxicity and Sub-Lethal Effects of Common Pesticides in Post-Larval and Juvenile Blue Crabs, Callinectes sapidus. GRO,MOR. Duke University Marine Laboratory, Nicholas School of the Environment, Duke University, 135 Duke Marine Lab Rd, Beaufort, NC 28516, USA, jso6@duke.edu//: 2012; 424/425, 5-14.
Rec #: 1900
Call Number: LITE EVAL CODED (ACP,ADC,GYPI,IMC,LCYT,NNCT), NO CONC (ADC)
Notes: EcoReference No.: 161498
Chemical of Concern: ACP,ADC,GYPI,IMC,LCYT

113. Page, M.; Ryan, R. B.; Rappaport, N., and Schmidt, F. Comparative Toxicity of Acephate, Diflubenzuron, and Malathion to Larvae of the Larch Casebearer, Coleophora laricella (Lepidoptera: Coleophoridae) and Adults of Its Parasites, Chrysocharis laricinellae and Dicladocerus nearcticus. MOR1982; 11, (3): 730-732.
Rec #: 400
Call Number: LITE EVAL CODED (ACP,DFZ,MLN)
Notes: EcoReference No.: 109860
Chemical of Concern: ACP,DFZ,MLN

114. Panda, S. K. and Mishra, D. S. Relative Toxicity of Insecticides to Whitebacked Planthopper, Sogatella furcifera (Horvath) and Its Predators in Rice. POP1998; 11, (1): 46-50.
Rec #: 1040
Call Number: LITE EVAL CODED (ACP,CPY,FNV), OK (DDVP,DFZ,DM,ES,FNT,IMC,MP,NNCT)
Notes: EcoReference No.: 103443
Chemical of Concern: ACP,BPZ,CPY,DDVP,DFZ,DM,ES,ETN,FNT,FNV,IMC,MP,NNCT,PPHD

115. Parker, R. D. Impact of At-Planting Insecticides on Aphids and Thrips in Cotton, 1998. GRO,POP1999; 24, 253-256 (F68).
Rec #: 820
Call Number: LITE EVAL CODED (ACP,ADC,IMC,NNCT)
Notes: EcoReference No.: 88143

Chemical of Concern: ACP,ADC,IMC,TMX

116. Patel, H. M.; Patel, P. U.; Dodia, J. F.; Patel, M. C.; Korat, D. M., and Mehta, K. G. Effect of Insecticides on Natural Enemies of Major Insect Pests of Paddy. POP1997; 22, (2): 147-151.
Rec #: 580
Call Number: LITE EVAL CODED (ACP,CPY,PRT), OK (CBF)
Notes: EcoReference No.: 93334
Chemical of Concern: ACP,CBF,CPY,PRT

117. Patil, C. S.; Pawar, S. A.; Mote, U. N., and Khaire, V. M. Evaluation of Insecticides Against Flea Beetles on Sorghum. POP1991; 12, 22-23.
Rec #: 730
Call Number: LITE EVAL CODED (ACP,DMT,ES), TARGET2012 (MLN,NMK)
Notes: EcoReference No.: 89317
Chemical of Concern: ACP,DMT,ES,MLN,NMK

118. Phugare, S. S.; Gaikwad, Y. B., and Jadhav, J. P. Biodegradation of Acephate Using a Developed Bacterial Consortium and Toxicological Analysis Using Earthworms (Lumbricus terrestris) as a Model Animal. BCM,CEL,PHY2012; 69, 1-9.
Rec #: 1790
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 159053
Chemical of Concern: ACP

119. Pike, K. S. Greenbug Protection in Seed-Treated Winter Wheat. GRO,POP,REP1978; 71, (5): 827-832.
Rec #: 800
Call Number: LITE EVAL CODED (ACP,DMT,MTM), NO ENDPOINT (OML), OK (ADC,CBF,DS,FMP,NNCT,NTZ)
Notes: EcoReference No.: 96448
Chemical of Concern: ACP,ADC,CBF,DEM,DMT,DS,FMP,IFP,MTM,NNCT,NTZ,OML

120. Power, K. T.; Shetlar, D. J.; Niemczyk, H. D., and Belcher, M. G. Control of Northern Masked Chafer Larvae on Turfgrass, 1996. PHY,POP1997; 22, 368-(46G).
Rec #: 1370
Call Number: LITE EVAL CODED (ACP,TCF), NO MIXTURE (FPP)
Notes: EcoReference No.: 153459
Chemical of Concern: ACP,FPP,IZF,TCF

121. ---. Control of the Black Turfgrass Ataenius Larvae on a Golf Course Fairway 1994. PHY,POP1995; 20, 273-274 (5G).
Rec #: 1350
Call Number: LITE EVAL CODED (ACP,LCYT,TCF)
Notes: EcoReference No.: 153458
Chemical of Concern: ACP,LCYT,TCF

122. Pradhan, S.; Roy, I.; Lodh, G.; Patra, P.; Choudhury, S. R.; Samanta, A., and Goswami, A. Entomotoxicity and Biosafety Assessment of Pegylated Acephate Nanoparticles: A Biologically Safe Alternative to Neurotoxic Pesticides. BCM,BEH,CEL,MOR. saheli.pradhan@gmail.com//: 2013; 48, (7): 559-569.
Rec #: 2000
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 165485
Chemical of Concern: ACP

123. Price, J. F. and Schuster, D. J. Effects of Natural and Synthetic Insecticides on Sweetpotato Whitefly Bemisia tabaci (Homoptera: Aleyrodidae) and Its Hymenopterous Parasitoids. MOR,PHY,POP1991; 74, (1): 60-68.

Rec #: 650
Call Number: LITE EVAL CODED (ACP,DMT,EFV,FPP,MTM), NO MIXTURE (PPB), OK (CBL,ES,OML,PMR)
Notes: EcoReference No.: 119551
Chemical of Concern: ABM,ACP,CBL,DMT,EFV,ES,FPP,HCCH,MTM,OML,PMR,PPB,PPCP,PYN

124. Purohit, T. J. Subacute Oral Toxicity Study of Acephate in Synthetic White Leghorn Birds. BCM,CEL,GRO,MOR2005: 173 p.
Rec #: 1640
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 154106
Chemical of Concern: ACP

125. Rao, N. V.; Reddy, A. S., and Reddy, P. S. Relative Efficacy of Some New Insecticides on Insect Pests of Cotton. POP1990; 18, (1): 53-58.
Rec #: 1030
Call Number: EFFICACY (PFF), LITE EVAL CODED (ACP,ALSV,ES,FPP,MTM), NO EFFECT (DMT), OK (ALSV,AMZ,CYP,MDT,MOIL,NMO), PESTS MANUAL (PFF), TARGET MANUAL (PFF)
Notes: EcoReference No.: 82101
Chemical of Concern: ACP,ALSV,AMZ,CYP,DMT,ES,ETN,FPP,IFP,MDT,MOIL,MTM,NMO,PFF,TPZ

126. Reardon, R. C. and Barrett, L. Effects of Treating Western Spruce Budworm Populations on Grand Fir and Douglas-Fir with Acephate, Carbofuran, Dimethoate, Oxydemeton-Methyl, and Methamidophos. ACC,POP1984; 8, (1): 1-10.
Rec #: 670
Call Number: LITE EVAL CODED (ACP,CBF,MTM), OK (DMT,OXD)
Notes: EcoReference No.: 89915
Chemical of Concern: ACP,CBF,DMT,MTM,OXD

127. Reay-Jones, F. P. F.; Way, M. O., and Reagan, T. E. Economic Assessment of Controlling Stem Borers (Lepidoptera: Crambidae) with Insecticides in Texas Rice. POP2007; 26, (7): 963-970.
Rec #: 550
Call Number: LITE EVAL CODED (ACP,AZX,CYP,DFZ,FPN,GCYH,LCYT,MFZ,TUZ)
Notes: EcoReference No.: 109862
Chemical of Concern: ACP,AZX,CYP,DFZ,FPN,GCYH,LCYT,MFZ,NVL,TUZ

128. Redak, R. A. and Bethke, J. A. Control of Silverleaf Whitefly on Poinsettia Under Greenhouse Conditions, Fall 1996. PHY,POP1997; 22, 387-(75G).
Rec #: 510
Call Number: LITE EVAL CODED (ACP,FAZ,FPP)
Notes: EcoReference No.: 100099
Chemical of Concern: ACP,FAZ,FPP

129. Reed, J. T. and Jackson, C. S. Evaluation of Seed Treatments and In-Furrow Insecticides for Thrips Control in Cotton in Mississippi, 1992. GRO,PHY,POP,REP1993; 18, 250-251 (81F).
Rec #: 230
Call Number: LITE EVAL CODED (ACP,ADC,DS,IMC,NNCT)
Notes: EcoReference No.: 151008
Chemical of Concern: ACP,ADC,DS,IMC

130. Reed, T. D.; Todd, J. W., and Bass, M. H. A New Technique for Determining the Effects of Soil Moisture on Insecticide Efficacy Against Lesser Cornstalk Borer Larvae. POP1987; 22, (2): 169-174.
Rec #: 240

Call Number: LITE EVAL CODED (ACP,CPY), TARGET2012 (CBF)
Notes: EcoReference No.: 153441
Chemical of Concern: ACP,CBF,CPY

131. Reinert, J. A.; Maranz, S. J., and Engelke, M. C. Fall Armyworm Control on a Bentgrass Green, Texas, 1997. PHY,POP1999; 24, 333-(G9).
Rec #: 1300
Call Number: LITE EVAL CODED (ACP,DM)
Notes: EcoReference No.: 153460
Chemical of Concern: ACP,DM

132. Reissig, H.; Dunham, M., and Smith, C. Secondary Insecticide Testing on Apple, 1997. POP1998; 23, 31-33 (19A).
Rec #: 250
Call Number: LITE EVAL CODED (ACP,LCYT), NO MIXTURE (EFV,FBOX,FPP,MOM,OML,PSM), TARGET2012 (AZ,DZ,IMC,NNCT,OML)
Notes: EcoReference No.: 150711
Chemical of Concern: ACP,AZ,DZ,EFV,FBOX,FPP,IMC,LCYT,MOM,NNCT,OML,PSM,PYX,TAP

133. Reissig, W. H.; Heinrichs, E. A., and Valencia, S. L. Effects of Insecticides on Nilaparvata lugens and Its Predators: Spiders, Microvelia atrolineata, and Cyrtorhinus lividipennis. POP1982; 11, (1): 193-199.
Rec #: 630
Call Number: LITE EVAL CODED (ACP,CPY,DMT,DZ,FNV,MOM,PPX,TVP), OK (CBF,DM,ES,MP)
Notes: EcoReference No.: 38491
Chemical of Concern: ACP,APP,CBF,CPY,DLM,DM,DMT,DZ,ES,FNTH,FNV,IZF,MOM,MP,PPHD,PPX,TVP

134. Rethwisch, M. D.; McDaniel, C. W.; Shaw, M., and Thiessen, J. Evaluation of Systemic Insecticides for Sweetpotato Whitefly Control on Seedling Cauliflower, 1991. GRO,PHY,POP1993; 18, 117-118 (36E).
Rec #: 260
Call Number: LITE EVAL CODED (ACP,DMT,MTM,OXD), OK (DS,ES)
Notes: EcoReference No.: 151009
Chemical of Concern: ACP,DMT,DS,ES,FNF,MTM,OXD

135. Rethwisch, M. D.; Natwick, E. T.; Tickes, B. R.; Meadows, M., and Wright, D. Impact of Insect Feeding and Economics of Selected Insecticides on Early Summer Bermudagrass Seed Production in the Desert Southwest. GRO,POP,REP1995; 20, (2): 187-201.
Rec #: 830
Call Number: LITE EVAL CODED (ACP,BFT,CBF,EFV,MOM), NO MIXTURE (MP), OK (CYP,DS)
Notes: EcoReference No.: 90192
Chemical of Concern: ACP,BFT,CBF,CYP,DS,EFV,EPRN,MOM,MP,PRN

136. Robertson, J. L.; Gillette, N. L.; Lucas, B. A.; Russell, R. M., and Savin, N. E. Comparative Toxicity of Insecticides to Choristoneura Species (Lepidoptera: Tortricidae). MOR1978; 110, (4): 399-406.
Rec #: 270
Call Number: LITE EVAL CODED (ACP,CPY,CPYM,MOM,PSM), OK (PMR,SMT), TARGET2012 (CBL,DM,FNT,MLN,RSM,TCF,TVP)
Notes: EcoReference No.: 162234
Chemical of Concern: ACP,CBL,CPY,CPYM,DDT,DM,FNT,FNTH,MLN,MOM,PMR,PSM,PYN,RSM,SMT,TCF,TVP

137. Robinson, J. R. C. and Teetes, G. L. Insecticides for Suppression of Heliothis spp. on Cotton, 1986. POP1987; 12, 248-250 (290).
Rec #: 920
Call Number: EFFICACY (PFF), LITE EVAL CODED (ACP,EFV,LCYT), NO MIXTURE (MP), OK (CYP), TARGET MANUAL (PFF), TARGET2012 (CBL)
Notes: EcoReference No.: 88708
Chemical of Concern: ACP,CBL,CYP,EFV,LCYT,MP,PFF

138. Rodriguez-Kabana, R. Nematicide Seed Treatment for Control of Nematodes in Cotton. GRO,POP1985: 18-19.
Rec #: 1840
Call Number: LITE EVAL CODED (ACP), NO EFFECT (CBX,Captan)
Notes: EcoReference No.: 163556
Chemical of Concern: ACP,CBX,Captan

139. Samsoe-Petersen, L. Laboratory Method for Testing Side-Effects of Pesticides on the Rove Beetle Aleochara bilineata - Adults. MOR,REP1987; 32, (1): 73-81.
Rec #: 940
Call Number: LITE EVAL CODED (ACP,BMC,CQTC,DM,MZB,SZ), OK (CTN,THM), TARGET2012 (AMZ,AZ,CBL,FNT)
Notes: EcoReference No.: 70278
Chemical of Concern:
ACP,AMZ,AZ,BMC,CBL,CQTC,CTN,Conazoles,DM,FNT,MZB,NAA,OTQ,SZ,THM

140. Schuster, D. J. Armyworm and Pepper Weevil Control on Bell Pepper in West-Central Florida, Spring 1995. POP1996; 21, 134-135 (71E).
Rec #: 350
Call Number: LITE EVAL CODED (CPY,MTM), OK (CYF,IMC,LCYT,NMX,NNCT,Naled,OML)
Notes: EcoReference No.: 64287
Chemical of Concern: CPY,CYF,CYT,IMC,LCYT,MTM,NMX,NNCT,Naled,OML

141. ---. Life-Stage Specific Toxicity of Insecticides to Parasitoids of Liriomyza trifolii (Burgess) (Diptera: Agromyzidae). MOR1994; 40, (2): 191-194.
Rec #: 970
Call Number: LITE EVAL CODED (FNV,MTM), OK (CYR,ES,MOM,PMR,TDC)
Notes: EcoReference No.: 74151
Chemical of Concern: ABM,CYR,ES,FNV,MOM,MTM,PMR,TDC

142. Semtner, P. J. Control of Tobacco Insect Pests on Flue-Cured Tobacco with Insecticides Applied in the Transplant Water, 1987. GRO,MOR,POP1988; 13, 316-317 (184F).
Rec #: 520
Call Number: LITE EVAL CODED (ACP), OK (ADC)
Notes: EcoReference No.: 88881
Chemical of Concern: ACP,ADC

143. ---. Insect Control on Flue-Cured Tobacco with Insecticides Applied to the Soil and in the Transplant Water, 1986. POP1987; 12, 300-(354).
Rec #: 880
Call Number: LITE EVAL CODED (ACP,ADC,PMR)
Notes: EcoReference No.: 88780
Chemical of Concern: ACP,ADC,PMR

144. Semtner, P. J.; Clarke, J., and Wilkinson III, W. Insect Control on Flue-Cured Tobacco with Foliar Insecticides, 1998. PHY,POP1999; 24, 312-313 (F131).
Rec #: 1450
Call Number: LITE EVAL CODED (ACP), NO MIXTURE (IMC,NNCT)

Notes: EcoReference No.: 153422
Chemical of Concern: ACP,IMC,NNCT,SS

145. Semtner, P. J.; Dara, S. K., and Wilkinson III, W. B. Insect Control on Flue-Cured Tobacco with Systemic Insecticides, 1995. POP1996; 21, 306-308 (147F).
Rec #: 1550
Call Number: LITE EVAL CODED (ACP,ADC,CBF,FMP,IMC,NNCT), NO MIXTURE (CPY,EP)
Notes: EcoReference No.: 153398
Chemical of Concern: ACP,ADC,CBF,CPY,EP,FMP,IMC,NNCT

146. ---. Tobacco Insect Control with Insecticides Applied in the Transplant Water, 1995. POP1996; 21, 309-310 (149F).
Rec #: 1560
Call Number: LITE EVAL CODED (ACP,ADC,IMC,NNCT)
Notes: EcoReference No.: 153399
Chemical of Concern: ACP,ADC,IMC

147. Semtner, P. J.; Litton, J., and Brock, A. Flea Beetle and Aphid Control with Transplant Water Treatments on Burley Tobacco, 1995. POP1996; 21, 306-(146F).
Rec #: 1540
Call Number: LITE EVAL CODED (ACP), TARGET2012 (IMC,NNCT)
Notes: EcoReference No.: 153397
Chemical of Concern: ACP,IMC,NNCT

148. Semtner, P. J.; Reed, M. B., and Komm, D. A. Tobacco Insect Control with NTN 33893, 1991. PHY,POP1992; 17, 298-(145F).
Rec #: 1400
Call Number: LITE EVAL CODED (ACP,IMC,NNCT)
Notes: EcoReference No.: 153389
Chemical of Concern: ACP,IMC,NNCT

149. Semtner, P. J. and Reed, T. D. Insect Control on Flue-Cured Tobacco with Foliar Insecticides, 1985. PHY,POP1987; 12, 304-(358).
Rec #: 890
Call Number: LITE EVAL CODED (ACP,MOM), TARGET2012 (CBL)
Notes: EcoReference No.: 88702
Chemical of Concern: ACP,CBL,MOM

150. ---. Insect Control on Flue-Cured Tobacco with Insecticides Applied in the Transplant Water, 1984. PHY,POP1987; 12, 302-(356).
Rec #: 860
Call Number: LITE EVAL CODED (ACP,OML,TDC), OK (ADC,FPN)
Notes: EcoReference No.: 88786
Chemical of Concern: ACP,ADC,FPN,OML,TDC

151. ---. Insect Control on Flue-Cured Tobacco with Insecticides Applied to the Soil and in the Transplant Water, 1985. PHY,POP1987; 12, 301-(355).
Rec #: 870
Call Number: LITE EVAL CODED (ACP,OML,TDC), NO MIXTURE (CBF,EP), OK (ADC,FPN)
Notes: EcoReference No.: 88781
Chemical of Concern: ACP,ADC,CBF,EP,FPN,OML,TDC

152. Semtner, P. J.; Reed, T. D., and Barnes, M. L. Tobacco Insect Control with Systemic Insecticides, 1990. POP1991; 16, 238-(141F).
Rec #: 1390
Call Number: LITE EVAL CODED (ACP,ADC), NO EFFECT (13DPE,DPDP), NO MIXTURE

(DS), OK (FMP), TARGET2012 (DS)
Notes: EcoReference No.: 153387
Chemical of Concern: 13DPE,ACP,ADC,DPDP,DS,FMP

153. Semtner, P. J. and Wilkinson III, W. B. Aphid and Flea Beetle Control on Tobacco with Insecticides Applied in the Transplant Water, 1997. POP1998; 23, 300-301 (155F).
Rec #: 1610
Call Number: LITE EVAL CODED (ACP,ADC,IMC,NNCT)
Notes: EcoReference No.: 153400
Chemical of Concern: ACP,ADC,IMC

154. ---. Insect Control of Flue-Cured Tobacco with Systemic Insecticides, 1997. POP1998; 23, 296-297 (152F).
Rec #: 1590
Call Number: LITE EVAL CODED (ACP,ADC,EP,FMP,IMC,NNCT), NO MIXTURE (CBF,CPY)
Notes: EcoReference No.: 153403
Chemical of Concern: ACP,ADC,CBF,CPY,EP,FMP,IMC,NNCT

155. ---. Insect Control on Dark Fire-Cured Tobacco, 1992. PHY,POP1993; 18, 288-(131F).
Rec #: 280
Call Number: LITE EVAL CODED (ACP,ADC,MOM), OK (ES,IMC,NNCT)
Notes: EcoReference No.: 151022
Chemical of Concern: ACP,ADC,ES,IMC,MOM,NNCT

156. ---. Insect Control on Flue-Cured Tobacco with Systemic Insecticides, 1994. POP1995; 20, 258-259 (136F).
Rec #: 1500
Call Number: LITE EVAL CODED (ACP,ADC,CBF,CPY,FMP,IMC,NNCT), NO MIXTURE (EP)
Notes: EcoReference No.: 153394
Chemical of Concern: ACP,ADC,CBF,CPY,EP,FMP,FNF,IMC,NNCT

157. ---. Insect Control on Flue-Cured Tobacco with Systemic Insecticides, 1996. POP1998; 23, 295-296 (151F).
Rec #: 1580
Call Number: LITE EVAL CODED (ACP,ADC,CBF,EP,FMP,IMC,NNCT), NO MIXTURE (CPY)
Notes: EcoReference No.: 153402
Chemical of Concern: ACP,ADC,CBF,CPY,EP,FMP,IMC,NNCT

158. ---. Tobacco Flea Beetle Control with Foliar Insecticides, 1993. PHY,POP1994; 19, 287-(150F).
Rec #: 1110
Call Number: LITE EVAL CODED (ACP,CBL,ES,MOM), NO MIXTURE (IMC,MPEDE,NNCT)
Notes: EcoReference No.: 106287
Chemical of Concern: ACP,CBL,ES,IMC,MOM,MPEDE,NNCT

159. ---. Tobacco Hornworm and Tobacco Budworm Control on Tobacco with Bacillus thuringiensis, 1993. POP1994; 19, 284-(147F).
Rec #: 1440
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 153392
Chemical of Concern: ACP,MOM

160. ---. Tobacco Insect Control with Insecticides Applied in the Transplant Water, 1994. POP1995; 20, 260-261 (137F).
Rec #: 1510
Call Number: LITE EVAL CODED (ACP,ADC,IMC,NNCT), NO MIXTURE (CPY)
Notes: EcoReference No.: 153395
Chemical of Concern: ACP,ADC,CPY,IMC

161. ---. Tobacco Insect Control with Insecticides Applied in the Transplant Water, 1996. POP1998; 23, 298-299 (154F).
Rec #: 1600
Call Number: LITE EVAL CODED (ACP,ADC,IMC,NNCT)
Notes: EcoReference No.: 153401
Chemical of Concern: ACP,ADC,IMC

162. ---. Tobacco Insect Control with Systemic Insecticides, 1993. POP1994; 19, 288-289 (151F).
Rec #: 1130
Call Number: LITE EVAL CODED (ACP,ADC,CPY,EP), OK (CBF,DS,FMP,IMC,NNCT)
Notes: EcoReference No.: 106286
Chemical of Concern: ACP,ADC,CBF,CPY,DS,EP,FMP,FNF,IMC,NNCT

163. Shaikh, N. P. Herbicide and Insecticide Interactions in Peanut (Arachis hypogaea L.). BCM,PHY,POP2004: 122 p.
Rec #: 810
Call Number: LITE EVAL CODED (ACP,ADC,CRME,FMX,PRT,SCA), NO MIXTURE (AZX,BT,CTN,MTC,NFZ,OXF,PDM,PMT,PQT)
Notes: EcoReference No.: 82752
Chemical of Concern: 24DB,ACP,ADC,AZX,BT,CRME,CTN,Conazoles,DEF,FMX,IAZ,IZT,MTC,NFZ,OXF,PDM,PMT,PQT,PRT,PYD,SCA,TEZ

164. Shamiyeh, N. B.; Gerhardt, B. R.; Mullins, C. A., and Straw, R. A. Control of Lepidopterous Pests on Cabbage, 1997. POPENV,MIXTURE; 1998; 23, 83-84 (15E).
Rec #: 1570
Call Number: LITE EVAL CODED (ACP,CYF,EFV,FPP,LCYT,MFZ,TUZ), NO MIXTURE (MTM)
Notes: EcoReference No.: 153427
Chemical of Concern: ACP,CYF,EFV,FPP,LCYT,MFZ,MTM,TUZ

165. Shamiyeh, N. B.; Roberts, C. H.; Mullins, C. A., and Straw, R. A. Control of Lepidopterous Pests on Cabbage, 1995. POP1996; 21, 96-97 (17E).
Rec #: 1530
Call Number: LITE EVAL CODED (ACP,CYF,EFV,FPP,LCYT,TUZ)
Notes: EcoReference No.: 153425
Chemical of Concern: ACP,CYF,EFV,FPP,LCYT,TUZ

166. Shean, B. and Cranshaw, W. S. Differential Susceptibilities of Green Peach Aphid (Homoptera: Aphididae) and Two Endoparasitoids (Hymenoptera: Encyrtidae and Braconidae) to Pesticides. GRO,MOR1991; 84, (3): 844-850.
Rec #: 1670
Call Number: LITE EVAL CODED (ACP,BFT), OK (ES)
Notes: EcoReference No.: 156539
Chemical of Concern: ABM,ACP,BFT,ES

167. Shetlar, D. J.; Power, K. T.; Belcher, M., and Niemczyk, H. D. Black Cutworm and Sod Webworm Larval Control on Golf Course Turfgrass Nursery, Medina County, OH, 1994. PHY,POP1995; 20, 276-277 (9G).
Rec #: 1520
Call Number: LITE EVAL CODED (ACP,CPY,CYF,LCYT), OK (AZD,BFT,CBL,PMR)
Notes: EcoReference No.: 153429
Chemical of Concern: ACP,AZD,BFT,CBL,CPY,CYF,IZF,LCYT,PMR

168. Solomon, J. D. Control of Sawfly Defoliators on Green Ash, 1986. PHY,POP1987; 12, 348-(436).
Rec #: 500

Call Number: LITE EVAL CODED (ACP,CBL,CPY,DZ)
Notes: EcoReference No.: 88771
Chemical of Concern: ACP,CBL,CPY,DZ

169. Sorenson, C. E.; Stephenson, A. S.; Clewis, S. B., and Ratz, C. E. Control of Tobacco Hornworms with Foliar Insecticides 1997A. POP1998; 23, 304-(161F).
Rec #: 1620
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 153433
Chemical of Concern: ACP,SS

170. ---. Control of Tobacco Hornworms with Foliar Insecticides, 1997B. POP1998; 23, 304-305 (162F).
Rec #: 1630
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 153434
Chemical of Concern: ACP,SS

171. Southern, P. S. and Browne, M. M. Tobacco Budworm Control on Flue-Cured Tobacco with Foliar Insecticides, 1996. PHY,POP1997; 22, 330-(143F).
Rec #: 290
Call Number: LITE EVAL CODED (ACP,MOM)
Notes: EcoReference No.: 153437
Chemical of Concern: ACP,MOM,SS

172. ---. Tobacco Flea Beetle Control with Soil Insecticides, 1986. POP1987; 12, 308-309 (363).
Rec #: 1120
Call Number: LITE EVAL CODED (ACP,ADC), OK (CBF), TARGET2012 (DS)
Notes: EcoReference No.: 88782
Chemical of Concern: ACP,ADC,CBF,DS

173. Speese III, J. Foliar Sprays to Control Insects in Fall Peppers, 1995. POP1996; 21, 136-137 (74E).
Rec #: 300
Call Number: LITE EVAL CODED (ACP,CYF,CYP,MOM,PMR)
Notes: EcoReference No.: 121316
Chemical of Concern: ACP,CYF,CYP,MOM,PMR

174. Steward, V. B. Control of Gelechiid Larvae Attacking Baldcypress in Pennsylvania, 1991. PHY,POP1992; 17, 357-(1H).
Rec #: 1410
Call Number: LITE EVAL CODED (ACP,BFT,MSO)
Notes: EcoReference No.: 153439
Chemical of Concern: ACP,BFT,MSO

175. Stoltz, R. L. and Matteson, N. A. Colorado Potato Beetle and Green Peach Aphid Control with Soil Applied Insecticides and Foliar Sprays, 1996. POP1997; 22, 162-163 (91E).
Rec #: 1470
Call Number: LITE EVAL CODED (ADC,CBF,IMC,MTM,NNCT,PRT), NO MIXTURE (CFP,EFV,OXD)
Notes: EcoReference No.: 153440
Chemical of Concern: ADC,CBF,CFP,EFV,IMC,MTM,NNCT,OXD,PRT

176. Studebaker, G. Efficacy of Selected Insecticides on Plant Bugs and Predatory Arthropods on Cotton, 1996. POP1997; 22, 272-273 (80F).
Rec #: 310
Call Number: LITE EVAL CODED (ACP,CYF,DM,FPN,MOM,OML,OXD), OK (CYP,DCTP,IMC,LCYT,NNCT)

Notes: EcoReference No.: 157436
Chemical of Concern: ACP,CYF,CYP,DCTP,DM,FPN,IMC,LCYT,MOM,NNCT,OML,OXD

177. Sweeden, M. B.; McLeod, P. J., and Russell, W. R. Acephate Effect on Dryland and Irrigated Cowpeas when Applied for Thrips (Thysanoptera: Thripidae) and Corn Earworm (Lepidoptera: Noctuidae) Control. POP1994; 87, (6): 1627-1631.
Rec #: 1430
Call Number: LITE EVAL CODED (ACP,EFV,MOM), NO EFFECT (TFN)
Notes: EcoReference No.: 153417
Chemical of Concern: ACP,EFV,MOM,TFN

178. Taylor, J. D.; Crowe, B. D., and McPherson, R. M. Control of Hornworms and Budworms and the Impact on Tobacco Aphid in Georgia Flue-Cured Tobacco, 1994. POP1996; 21, 314-315 (155F).
Rec #: 480
Call Number: LITE EVAL CODED (ACP,MOM), TARGET2012 (CBL)
Notes: EcoReference No.: 105614
Chemical of Concern: ACP,CBL,MOM

179. ---. Control of Late Season Hornworms in Georgia Flue-Cured Tobacco, 1995. POP1996; 21, 315-(156F).
Rec #: 490
Call Number: LITE EVAL CODED (ACP), OK (ES), TARGET2012 (CBL)
Notes: EcoReference No.: 104851
Chemical of Concern: ACP,CBL,ES

180. Taylor, J. D.; McPherson, R. M., and Crowe, B. D. Late-Season Tobacco Hornworm Control in Georgia Flue-Cured Tobacco, 1997. POP1998; 23, 306-(164F).
Rec #: 1810
Call Number: LITE EVAL CODED (ACP,FPP,LCYT), NO EFFECT (FMP,MLX)
Notes: EcoReference No.: 158013
Chemical of Concern: ACP,FMP,FPP,LCYT,MLX,NPP,PYX,SS

181. Thimmaiah, G. Comparative Efficacy of Certain New Insecticides in the Control of Leaf Hoppers and Bollworms of Cotton. POP,REP1985; 19, (2): 90-94.
Rec #: 1460
Call Number: LITE EVAL CODED (DCTP,MTM), OK (ES,MP), TARGET2012 (CBL)
Notes: EcoReference No.: 153435
Chemical of Concern: CBL,DCTP,DDT,ES,MP,MTM,TXP

182. Tien, C. J. and Chen, C. S. Assessing the Toxicity of Organophosphorous Pesticides to Indigenous Algae with Implication for Their Ecotoxicological Impact to Aquatic Ecosystems. POP2012; 47, (9): 901-912.
Rec #: 1770
Call Number: LITE EVAL CODED (CPY,MOL,MTM,TBO)
Notes: EcoReference No.: 157805
Chemical of Concern: CPY,MOL,MTM,TBO

183. Tillman, P. G. Susceptibility of Three Parasitoids of Heliothis virescens to Field Rates of Selected Cotton Insecticides. MOR. Integrated Pest Management Laboratory,ARS,Starkville,MS////: 1996; 2, 793-796.
Rec #: 320
Call Number: LITE EVAL CODED (ACP,AZ,BFT,CFP,CPY,CYF,CYH,CYP,DCTP,DMT,EFV,ES,FPN,MOM,MP,OML,PFF,TDC), NO ENDPOINT (EFV)
Notes: EcoReference No.: 155866
Chemical of Concern: ACP,AZ,BFT,CFP,CPY,CYF,CYH,CYP,DCTP,DMT,EFV,ES,FPN,MOM,MP,OML,PFF,TDC

184. Tomlin, A. D. Toxicity of Soil Applications of Insecticides to Three Species of Springtails (Collembola) Under Laboratory Conditions. MOR1975; 107, 769-774.
Rec #: 1190
Call Number: LITE EVAL CODED (ACP,MOM,PRT,PTSN,PTSO,TBO,TMP), OK (CBF)
Notes: EcoReference No.: 67151
Chemical of Concern: ACP,CBF,DDT,HPT,MOM,PRT,PTSN,PTSO,TBO,TMP

185. Tripathi, S. M.; Thaker, A. M.; Joshi, C. G., and Sankhala, L. N. Acephate Immunotoxicity in White Leghorn Cockerel Chicks upon Experimental Exposure. BCM,BEH,CEL,GRO,PHY2012; 34, 192-199.
Rec #: 1880
Call Number: LITE EVAL CODED (ACP)
Notes: EcoReference No.: 165240
Chemical of Concern: ACP

186. Van den Berg, J. and Van Rensburg, J. B. J. Importance of Persistence and Synergistic Effects in the Chemical Control of Chilo partellus (Lepidoptera: Pyralidae) on Grain Sorghum. POP1993; 7, (1): 5-7.
Rec #: 840
Call Number: LITE EVAL CODED (CYF,MTM,TCF), NO MIXTURE (DM,ES,FNV)
Notes: EcoReference No.: 104594
Chemical of Concern: CYF,DM,ES,FNTH,FNV,MTM,TCF

187. Vernon, R. S. and Mackenzie, J. R. Evaluation of Foliar Sprays Against the Tuber Flea Beetle, Epitrix tuberis Gentner (Coleoptera: Chrysomelidae), on Potato. POP. Agric. Canada Res. Station, 6660 NW Marine Dr., Vancouver, British Columbia V6T 1X2, Canada.//: 1991; 123, (2): 321-331.
Rec #: 1480
Call Number: LITE EVAL CODED (CPY,CYF,DM,FNV,LCYT,MTM,PRT), OK (CYP,ES,PMR), TARGET2012 (BFT,CBL)
Notes: EcoReference No.: 153356
Chemical of Concern: BFT,CBL,CPY,CYF,CYP,DM,ES,FNV,LCYT,MTM,PMR,PRT

188. Walgenbach, J. F. and Estes, E. A. Economics of Insecticide Use on Staked Tomatoes in Western North Carolina. POP1992; 85, (3): 888-894.
Rec #: 560
Call Number: EFFICACY (EFV), LITE EVAL CODED (MOM,MTM), OK (ES), PESTS MANUAL (EFV), TARGET MANUAL (EFV), TARGET2012 (CBL)
Notes: EcoReference No.: 112251
Chemical of Concern: CBL,EFV,ES,MOM,MTM

189. Wang, H. Y.; Yang, Y.; Su, J. Y.; Shen, J. L.; Gao, C. F., and Zhu, Y. C. Assessment of the Impact of Insecticides on Anagrus nilaparvatae (Pang et Wang) (Hymenoptera: Mymanidae), an Egg Parasitoid of the Rice Planthopper, Nilaparvata lugens (Hemiptera: Delphacidae). GRO,MOR,REP2008; 27, (3-5): 514-522.
Rec #: 360
Call Number: LITE EVAL CODED (CPY,FPN,HFR,MTM), OK (DDVP,IMC,NNCT)
Notes: EcoReference No.: 102534
Chemical of Concern: ABM,BPZ,CPY,DDVP,FPN,HFR,IMC,MTM,NNCT,TMX

190. Wang, X.; Li, E.; Xiong, Z.; Chen, K.; Yu, N.; Du, Z., and Chen, L. Low Salinity Decreases the Tolerance to Two Pesticides, beta-Cypermethrin and Acephate, of White-Leg Shrimp, Litopenaeus vannamei. MOR2013; 4, (5): 5 p.
Rec #: 1940
Call Number: LITE EVAL CODED (ACP,CYP)
Notes: EcoReference No.: 165243
Chemical of Concern: ACP,CYP

191. Wang, Y.; Wu, S.; Chen, L.; Wu, C.; Yu, R.; Wang, Q., and Zhao, X. Toxicity Assessment of 45 Pesticides to the Epigeic Earthworm Eisenia fetida. MOR. State Key Laboratory Breeding Base for Zhejiang Sustainable Pest and Disease Control, Institute of Quality and Standard for Agro-products, Zhejiang Academy of Agricultural Sciences, Hangzhou 310021, Zhejiang, China, zhaoxueping@tom.com. Elsevier BV//: 2012; 88, (4): 484-491.
Rec #: 1860
Call Number: LITE EVAL CODED (ACP,ATZ,AZX,CBL,FNPPE,FTL,GFSNH,GYP,MLN,MTC,MTSM,NaDPA,PQT,PRB,PRM,QZFPE,SMM,TFN)
Notes: EcoReference No.: 159988
Chemical of Concern: ACO,ACP,ANL,ATZ,AZX,BPZ,CBL,CPZ,CTD,Conazoles,ECZ,FNPPE,FTL,GFSNH,GYP,HCZ,LUF,MLN,MTC,MTSM,NNCT,NaDPA,PQT,PRB,PRM,QZFPE,RIM,SMM,TEZ,TFN,TFX

192. Ward, C. R.; Huddleston, E. W.; Ashdown, D.; Owens, J. C., and Polk, K. L. Greenbug Control on Grain Sorghum and the Effects of Tested Insecticides on Other Insects. POP1970; 63, (6): 1929-1934.
Rec #: 790
Call Number: LITE EVAL CODED (AZ,DS,DZ,MDT,MLN,MP,MTM,MVP)
Notes: EcoReference No.: 114828
Chemical of Concern: AZ,DEM,DS,DZ,EN,EPRN,ETN,MDT,MLN,MP,MTM,MVP,PPHD,PRN

193. Way, M. O. and Wallace, R. G. Control of Rice Water Weevil with Fipronil and Acephate, 1994. PHY,POP1995; 20, 228-(104F).
Rec #: 1490
Call Number: LITE EVAL CODED (ACP,CBF,FPN)
Notes: EcoReference No.: 153413
Chemical of Concern: ACP,CBF,FPN

194. Weaver, J. E. and McCutcheon, T. W. Green June Beetle Control, West Virginia, 1987. POP1988; 13, 270-271 (121F).
Rec #: 780
Call Number: LITE EVAL CODED (ACP,CBL,DZ,LCYT), TARGET2012 (CYF,TCF)
Notes: EcoReference No.: 88816
Chemical of Concern: ACP,CBL,CYF,DZ,IFP,IZF,LCYT,TCF

195. Whitehead, A. G.; Bromilow, R. H.; Fraser, J. E., and Nichols, A. J. F. Control of Potato Cyst-Nematode, Globodera rostochiensis, and Root-Knot Nematode, Meloidogyne incognita, by Organophosphorus, Carbamate, Benzimidazole and Other Compounds. GRO,POPSOIL,ENV; 1985; 106, (1): 489-498.
Rec #: 330
Call Number: LITE EVAL CODED (CPY,MOM,MTM,PIRE,PIRM), NO ENDPOINT (ACP,AMZ,AZ,CBL,CBX,CLNB,CTN,DDVP,DMT,FNT,MDT,MVP,RTN,TCF), OK (ADC,BMY,CBD,CBF,CMPH,DS,FMP,MP,TBO), TARGET MANUAL (EP,OML), TARGET2012 (CBL)
Notes: EcoReference No.: 164090
Chemical of Concern: ACP,ADC,AMZ,AZ,BDC,BMY,CBD,CBF,CBL,CBX,CLNB,CMPH,CPY,CTN,DDVP,DEET,DEM,DMT,DS,DTM,EP,EPRN,FMP,FNF,FNT,FNTH,MDT,MOM,MP,MTM,MVP,MXC,NSM,OML,OXC,PIRE,PIRM,PRN,RTN,TBA,TBO,TCF,TPE,TPM

196. Wier, A. T.; Thomas, J. D.; Boyd, M. L., and Boethel, D. J. Control of Southern Green Stink Bug and Velvetbean Caterpillar on Soybean, 1992. POP1993; 18, 277-278 (118F).
Rec #: 1420
Call Number: LITE EVAL CODED (ACP,TLM), TARGET2012 (IMC,MP,NNCT)
Notes: EcoReference No.: 153419
Chemical of Concern: ACP,IMC,MP,NNCT,TLM

197. Yang, J.; Cao, J.; Sun, X.; Feng, Z.; Hao, D.; Zhao, X., and Sun, C. Effects of Long-Term Exposure to Low Levels of Organophosphorous Pesticides and Their Mixture on Altered Antioxidative Defense Mechanisms and Lipid Peroxidation in Rat Liver. BCM,GRO,MOR. xiujuan_zhao@sina.com//: 2012; 30, (2): 122-128.
Rec #: 1780
Call Number: LITE EVAL CODED (ACP,DDVP,DMT,PRT)
Notes: EcoReference No.: 161035
Chemical of Concern: ACP,DDVP,DMT,PRT

198. Younis, A. M.; Rodriguez, L. M.; Skias, J. M., and Reagan, T. E. Effects on Non-Target Arthropods from Sugarcane Borer Control Large Plot Field Trial, 1992. POP1993; 18, 280-(122F).
Rec #: 1650
Call Number: LITE EVAL CODED (ACP,AZ,EFV,MTM), NO MIXTURE (CYF)
Notes: EcoReference No.: 154854
Chemical of Concern: ACP,AZ,CYF,EFV,MTM

199. Yu, Z.; Jiang, A., and Wang, C. Oxygen Consumption, Ammonia Excretion, and Filtration Rate of the Marine Bivalve Mytilus edulis Exposed to Methamidophos and Omethoate. BCM,BEH,MOR,PHY2010; 43, (4): 243-255.
Rec #: 1910
Call Number: LITE EVAL CODED (MTM,OMT)
Notes: EcoReference No.: 162803
Chemical of Concern: MTM,OMT

200. Zhang, Q. and Wang, C. Toxicity of Binary Mixtures of Enantiomers in Chiral Organophosphorus Insecticides: The Significance of Joint Effects Between Enantiomers. MOR2013; 25, (11): 787-792.
Rec #: 1980
Call Number: LITE EVAL CODED (MTM,PFF)
Notes: EcoReference No.: 165491
Chemical of Concern: K2Cr2O7,MTM,PFF

APPENDIX F. Acephate and Methamidophos Incidents

Contents:

Notes:

1. EIIS = Ecological Incident Information System
2. There were no incidents in the aggregate minor incident report for methamidophos

EIIS Acephate Reports:

EIIS Pesticide Summary Report: General Information

Acephate (103301)

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
AQUATIC								
COTTON								
I000592-001	6/13/1993	MILAM	TX	1	RU		Broadcast	40
FIELD								
I000256-020	8/1/1992		SC	3	UN	N/R	N/R	SMALL FISHKILL
Ornamental, woody								
I000468-001	6/6/1992	ALLEGHENY	PA	2	RU	N/R	N/R	Unknown
TOBACCO								
I000799-009	6/23/1991	ONSLOW	NC	1	RU	F	Spray	400
Turf, golf course								
I022297-003	1/25/2010	Charlotte	FL	1	RU			10
PLANTS								
Agricultural Area								
I007340-706	5/27/1998		GA	2	UN		N/R	UNKNOWN
I007340-704	5/27/1998		PA	2	UN		N/R	UNKNOWN
Bell peppers								

Thursday, January 21, 2016 Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
I016036-004	5/17/2004	Stanislaus	CA	1	RU		Spray	40 acres
HOME/LAWN								
I001777-002	12/5/1994		PA	3	RU		Spray	UNKNOWN
I008693-042	4/23/1999			2	UN	N/R	N/R	LAWN AND PLANTS
I009262-091	8/2/1999	FULTON	GA	3	UN	N/R	Spray	UNKNOWN
HOME/TREE								
I009262-116	8/2/1999	VANDERBURGH	IN	3	RU	N/R	N/R	UNKNOWN
I009262-117	8/3/1999	SCHLEICHER	TX	3	RU	N/R	N/R	50
Ornamental								
I007340-619	4/22/1998		FL	2	UN		N/R	UNKNOWN
Peanut								
I011838-060	5/20/2001	CADDO	OK	2	UN			58 acres
Residential								
I024179-398		Roanoke	VA	2	UN	N/R	N/R	>45% plants
Tree farm/plantation								
I022048-001	5/25/2010	Beaufort	NC	2	UN			1000 acres
TREE NURSERY								
I007776-004	9/15/1998	HOUSTON	AL	2	RU		SPRAYING	ALL
YARD								
I009262-105	8/6/1999	DISTRICT OF COLU	DC	3	UN	N/R	Spray	1

Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
TERRESTRIAL								
No Data								
I027663-001	4/27/2015	Fulton	OH	1	RU			
Mint								
I014409-070	8/8/1992	Adams	WA	2	RU			Not given
I014409-071	8/8/1992	Adams	WA	2	RU			Not given
N/R								
I014409-060	7/29/1992	Grant	WA	2	RU			Not given
I014409-064	8/6/1992	Yakima	WA	3	UN			Approx 48
I014409-065	8/6/1992	Yakima	WA	3	UN			Approx. 60 hives
I014409-068	8/8/1992	Franklin	WA	3	UN			40 hives
I014409-067	8/8/1992	Franklin	WA	3	UN			48 hives
I014407-019	8/1/1994	Grant	WA	2	UN			
I004535-003	9/3/1996			3	UN			1
I013135-001	6/30/2002		TX	2	UN			2
Residential								
I026563-001	6/17/2014	Lane	OR	4	M			Sidewalks littered
Turf, public area								
I007109-001	3/25/1998	Charleston	SC	3	UN			24
Turf, residential area								

Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
I016176-001	3/11/2005	Georgetown	SC	4	RU			50
Watermelon								
I026024-001	7/1/2013	Dunklin	MO	2	UN		N/R	

EIIS Pesticide Summary Report: Species Information

Acephate (103301)

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
AQUATIC					
COTTON					
I000592-001					
	catfish	Ictaluridae	40	mortality	Runoff
	perch	Percidae	n/r	mortality	Runoff
FIELD					
I000256-020					
	unknown fish		n/r	mortality	Runoff
Ornamental, woody					
I000468-001					
	unknown fish		some	mortality	N/R
TOBACCO					
I000799-009					
	bass	Micropterus spp.	hundreds	mortality	Runoff
	bream	Notemigonus crysoleucas		mortality	Runoff
	catfish	Ictaluridae	hundreds	mortality	Runoff
	crappie	Centrarchidae	hundreds	mortality	Runoff
	eel	Anguilliformes	hundreds	mortality	Runoff
Turf, golf course					

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
I022297-003					
	suckermouth catfish	Hypostomus plecostomus	10	mortality	Treated directly

PLANTS

Agricultural Area					
I007340-704					
	ornamental		unknown	plant damage	Treated directly
I007340-706					
	ornamental		unknown	plant damage	Treated directly
Bell peppers					
I016036-004					
	pepper		40 acres	plant damage	Treated directly
HOME/LAWN					
I001777-002					
	rose	Rosa	thousands	plant damage	Drift
I008693-042					
	grass		lawn and plants	mortality	Treated directly
I009262-091					
	grass		unknown	plant damage	Treated directly
HOME/TREE					
I009262-116					
	almond		unknown	mortality	Treated directly
	hibiscus		unknown	mortality	Treated directly
I009262-117					
	shrub		unknown	mortality	Treated directly

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
Ornamental					
I007340-619					
	ornamental		unknown	plant damage	Treated directly
Peanut					
I011838-060					
	peanut	Arachis hypogaea	58 acres	plant damage	Treated directly
Residential					
I024179-398					
	ornamental		>45%	mortality	N/R
Tree farm/plantation					
I022048-001					
	corn, field	Zea mays	1000 acers	plant damage	Drift, spray
TREE NURSERY					
I007776-004					
	pine	Pinus sp.		plant damage	Treated directly
YARD					
I009262-105					
	dwarf alberta pine		1	mortality	Treated directly

TERRESTRIAL

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
No Data					
I027663-001					
	unknown butterfly	Lepidoptera	4	mortality	Ingestion

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
Mint					
I014409-070					
	bee	Apidae	not given	mortality	N/R
I014409-071					
	bee	Apidae	not given	mortality	N/R
N/R					
I004535-003					
	unknown bird		1	incapacitation	N/R
I013135-001					
	rabbit	Leporidae	1	mortality	N/R
	unknown bird		1	mortality	N/R
I014407-019					
	bee	Apidae		mortality	Drift
I014409-060					
	bee	Apidae	not given	mortality	N/R
I014409-064					
	bee	Apidae	approx. 48 colonies	mortality	N/R
I014409-065					
	bee	Apidae	approx. 60 colonies	mortality	N/R
I014409-067					
	bee	Apidae	48 hives	mortality	
I014409-068					
	bee	Apidae	40 colonies	mortality	N/R
Residential					
I026563-001					

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
	bumble bee	Bombus sp.		mortality	
Turf, public area					
I007109-001					
	boat-tailed grackle	Cassidix mexicanus	24	mortality	N/R
Turf, residential area					
I016176-001					
	boat-tailed grackle	Cassidix mexicanus	50	mortality	Ingestion
Watermelon					
I026024-001					
	honey bee	Apis millifera	1,000 hives	incapacitation	

EIIS Methamidophas Reports:

EIIS Pesticide Summary Report: General Information

Methamidophos (101201)

	Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
PLANTS									
FIELD									
	I007776-009	9/4/1998	DADE	FL	2	RU		SPRAY	30 ACRES
JALAPENO PEPPERS									
	I006793-006		DADE	FL	2	RU		N/R	30 ACRES PEPPERS
Potato									
	I013587-013	7/16/1999	ADAMS	WA	1	RU		Spray	Unknown
TERRESTRIAL									
No Data									
	I023688-001	7/8/2010	Sarasota	FL	2	UN			16
Agricultural Area									
	I005980-002	6/1/1997	MERCED	CA	3	RU	N/R	N/R	700
Alfalfa									
	I013587-012	7/14/1999	Grant	WA	2	UN			150 Hives
	I010875-002	7/1/2000			3	MA	F	N/R	4 BOARDS HONEY BEES
Broccoli									

Thursday, January 21, 2016

Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
I002680-001	10/27/1987	MONTEREY	CA	3	UN			4
CABBAGE								
B0000-400-23	7/1/1980		WI	3	UN		N/R	UNKNOWN
N/R								
I014409-068	8/8/1992	Franklin	WA	3	UN			40 hives
I014409-067	8/8/1992	Franklin	WA	3	UN			48 hives
I014409-069	8/8/1992	Franklin	WA	3	UN			60 colonies
I013884-010	6/26/1998	Grant	WA	4	UN		Spray	about 500 colonies
I014341-033	1/1/1999	Grant	WA	2	UN			200 hives
I014341-034	1/1/1999	Grant	WA	2	UN			30 hives
Potato								
I013883-018	7/15/1997	GRANT	WA	2	RU		Spray	Not given
Turf, public area								
I007109-001	3/25/1998	Charleston	SC	2	UN			24
Wheat								
I014409-061	7/30/1992	Walla Walla	WA	2	RU			Not given

Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

EIIS Pesticide Summary Report: Species Information
Methamidophos (101201)

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
PLANTS					
FIELD					
I007776-009					
	jalapeno pepper		30 acres	plant damage	SPRAY RESIDUE
JALAPENO PEPPERS					
I006793-006					
	jalapeno pepper		30 acres	plant damage	Treated directly
Potato					
I013587-013					
	potato		unknown	plant damage	Treated directly
TERRESTRIAL					
No Data					
I023688-001					
	wood stork	Mycteria americana	16	mortality	N/R
Agricultural Area					
I005980-002					
	bee	Apidae	700	mortality	Drift
ALFALFA					

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
I010875-002					
	bee	Apidae	4 boards; 5-6 hives	mortality	Ingestion
I013587-012					
	bee	Apidae	150 colonies exposed	mortality	Drift, spray
Broccoli					
I002680-001					
	california quail	Callipepla californica	4	mortality	Ingestion
CABBAGE					
B0000-400-23					
	barn swallow	Hirundo rustica	unknown	mortality	Ingestion
	house sparrow	Passer domesticus	unknown	mortality	Ingestion
	killdeer	Charadrius vociferus	unknown	mortality	Ingestion
	starling	Sturnus vulgaris	unknown	mortality	Ingestion
N/R					
I013884-010					
	bee	Apidae	about 500 colonies	mortality	Drift, spray
I014341-033					
	bee	Apidae	200 hives	mortality	Ingestion
I014341-034					
	bee	Apidae	30 hives	mortality	N/R
I014409-067					
	bee	Apidae	48 hives	mortality	
I014409-068					
	bee	Apidae	40 colonies	mortality	N/R
I014409-069					

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
	bee	Apidae	60 hives	mortality	N/R
Potato					
I013883-018					
	leafcutter bee	Megachile sp.	not given	mortality	Drift, spray
Turf, public area					
I007109-001					
	boat-tailed grackle	Cassidix mexicanus	24	mortality	N/R
Wheat					
I014409-061					
	leafcutter bee	Megachile sp.	not given	mortality	N/R

IDS Report Summary:

PC Codes Selected :	103301;101201		
Ingredient Name :	All	Incident Date Period:	1/1/1995 TO 1/21/2016
Exposure Severity Cod	All	Submission Date Per	ALL

PC Code	Ingredient Name	Total Inc.	HD	HE	DA	DB	DCDE	DC	DD	DE	WB	PB	ONT	GB	GC	WB	WC	GWB	GWC	SWB	SWC	PDB	PDC
101201	Methamidophos	6	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101201	Methamidophos (ANSI)	20	15	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103301	Acephate	1871	1176	11	33	28	16	#	#	0	6	127	0	0	0	0	0	0	0	0	0	0	1
103301	Acephate (ANSI)	3892	2458	51	85	49	23	#	#	53	5	332	0	0	0	0	0	0	0	0	0	0	3
103301	Orthene	11	5	1	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Exposure Severity Code	Description
DA	Domestic Animal - Fatality
DB	Domestic Animal - Major
DC	Domestic Animal - Moderate
DCDE	Domestic Animal - Moderate, Minor and Unknown
DD	Domestic Animal - Minor
DE	Domestic Animal - Unspecified
DWB	Drinking Water - Moderate
DWC	Drinking Water - Minor
GB	Groundwater - Moderate (with possibly mixed types of water)
GC	Groundwater - Minor (with possibly mixed types of water)
GWB	Groundwater - Moderate
GWC	Groundwater - Minor
HD	Human - Minor
HE	Human - Unspecified
ONT	Other Nontarget
PB	Plant Damage - Minor
PDB	Property Damage - Moderate
PDC	Property Damage - Minor
SWB	Surface Water - Moderate
SWC	Surface Water - Minor
WB	Wildlife - Minor

AIMS Querry Results for Acephate

Summary of AIMS Query

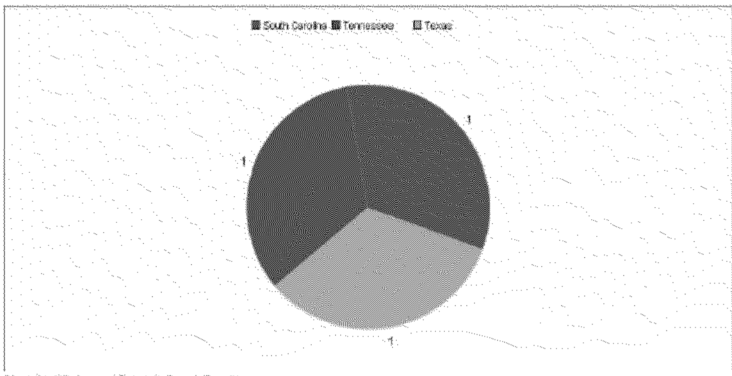
Logout

State/Province Summary

Please note that analysis of AIMS data by state or any geographic criteria most likely indicates the status of data collection efforts, rather than the occurrence of incidents. No records in a given location may indicate a lack of reporting, rather than a lack of incidents.

State/Province	# Events	# Birds Killed	# Birds Sub-lethally Affected
South Carolina	1	45	
Tennessee	1	8	
Texas	1	1	

See All State/Provinces

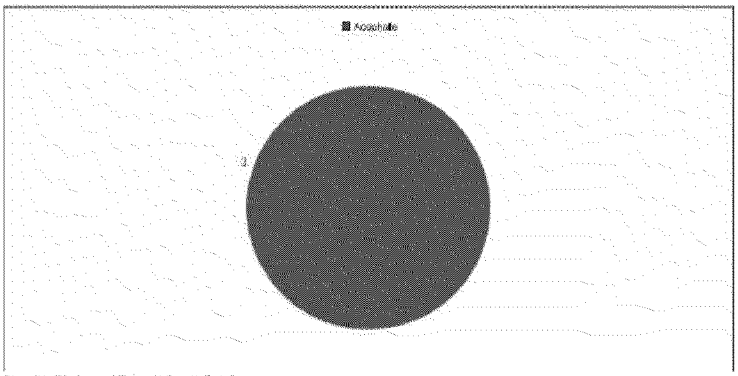


Close this Window and Return to Search Results

Pesticide Summary

Pesticide	# Events	# Birds Killed	# Birds Sub-lethally Affected
Acephate	3	54	

See All Pesticides



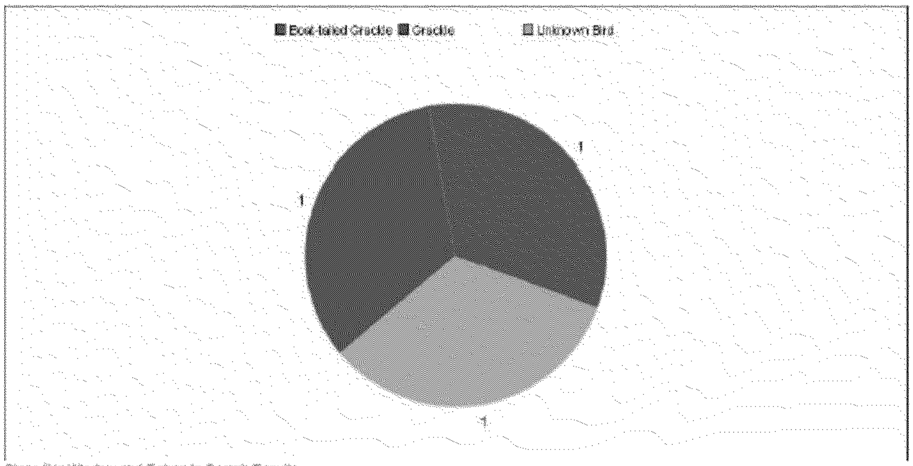
Close this Window and Return to Search Results

Species Summary

Please note that incomplete species names have sometimes been reported. This may lead to multiple columns for related or similar species names (i.e. 'American Crow' and 'Crow').

Species	# Events	# Birds Killed	# Birds Sub-lethally Affected
Boat-tailed Grackle	1	45	
Grackle	1	8	
Unknown Bird	1	1	

See All Species



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AIMS Database Search Results Logout

You searched for: **acephate** in Keyword

New Simple Search New Advanced Search

Your AIMS Database query returned **3 Records.**

View Summary Report for these Incidents

Birds listed in green are on the ABC Greenlist.

Event ID	Date (mm/dd/yyyy)	Location	Species	Pesticide(s)
1651	Start: 06/30/2002	County: Unknown	Unknown Bird	Acephate
	End:	State: TX	**Sources:**	**EIIS:** I013135-001
1960	Start: 01/01/2003	County: Bradley	Grackle	Acephate
	End: 12/31/2003	State: TN	**Sources:**	**FWSLE:** Case 03-0342 **FWSLE (INV):** 2003402804
2598	Start: 03/11/2005	County: Georgetown	Boat-tailed Grackle	Acephate
	End: 03/16/2005	State: SC	**Sources:**	**EIIS:** I016176-001

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- Pesticide Profiles
- National Pesticide Reform Coalition

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- Contact Us

Summary of AIMS Query

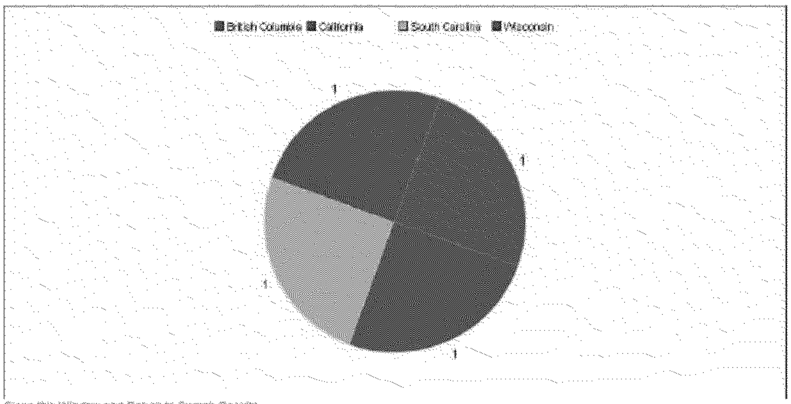
Logout

State/Province Summary

Please note that analysis of AIMS data by state or any geographic criteria most likely indicates the status of data collection efforts, rather than the occurrence of incidents. No records in a given location may indicate a lack of reporting, rather than a lack of incidents.

State/Province	# Events	# Birds Killed	# Birds Sub-lethally Affected
British Columbia	1	1	2
California	1	4	
South Carolina	1	24	
Wisconsin	1	4	

See All State/Provinces

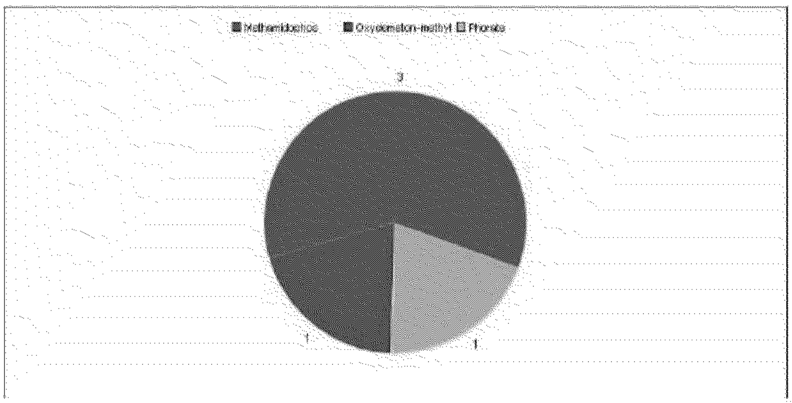


Close this Window and Return to Search Results

Pesticide Summary

Pesticide	# Events	# Birds Killed	# Birds Sub-lethally Affected
Methamidophos	3	32	
Oxydemeton-methyl	1	4	
Phorate	1	1	2

See All Pesticides



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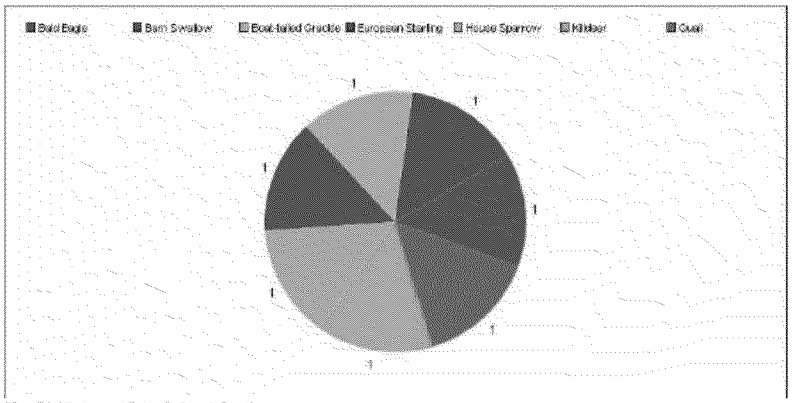
Species Summary

Please note that incomplete species names have sometimes been reported. This may lead to multiple columns for related or similar species names (i.e. 'American Crow' and 'Crow').

Species	# Events	# Birds Killed	# Birds Sub-lethally Affected
Bald Eagle	1	1	2
Barn Swallow	1	1	
Boat-tailed Grackle	1	24	
European Starling	1	1	
House Sparrow	1	1	
Killdeer	1	1	
Quail	1	4	

See All Species



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AIMS Database Search Results Logout

You searched for: **Methamidophos** in Keyword

New Simple Search New Advanced Search

Your AIMS Database query returned **4 Records.**

View Summary Report for these Incidents

Birds listed in green are on the ABC Greenlist.

Event ID	Date (mm/dd/yyyy)	Location	Species	Pesticide(s)
99	Start: 07/01/1980	County: Unknown	Barn Swallow European Starling House Sparrow Killdeer	Methamidophos
	End: 07/31/1980	State: WI	**Sources:**	**EIIS**: B0000-400-23
358	Start: 10/27/1987	County: Monterey	Quail	Methamidophos Oxydemeton-methyl
	End:	State: CA	**Sources:**	**CA**: P-100 **EIIS**: I002680-001
1156	Start: 03/25/1998	County: Charleston	Boat-tailed Grackle	Methamidophos
	End:	State: SC	**Sources:**	**EBSP**: 56-98 **EIIS**: I007109-001
2605	Start: 01/13/1992	County: N/A	Bald Eagle	Phorate
	End: 02/02/1992	State: BC	**Sources:**	**EIIS**: I015522-001

APPENDIX G. Aquatic RQ Calculations and T-REX and TerrPlant Inputs/Outputs

Aquatic RQ Calculations:

Calculations: RQs = EEC(in mg a.i./L)/1000{conversion to ug ai/L}÷ Endpoint (in ug ai/L)

Using methadidophos toxicity endpoints (except frog which was converted from acephate data):

	Methamidophos EEC's, in ug ai/L			RQs												
Crop	Peak	21d EEC	60d EEC	Fish Ac	Fish Chr	Frog Ac	Inv Ac	Inv Chr	E/M F Ac	E/M Inv Ac	E/M Inv Ch	Vas	Vas List	Nonvas	Nonvas List
A + K) cotton	32.6	8.84	3.77	1.30E-03	0.022	6.58E-06	**1.254**	**1.964**	0.0058	0.031	0.051	0.0089	0.0230	0.000048	0.00111
B) wasteland	37.5	14	9.56	1.50E-03	0.056	7.57E-06	**1.442**	**3.111**	0.0067	0.036	0.080	0.0103	0.0264	0.000055	0.00127
D+I) peanuts, seed treatment	17.1	5.97	2.81	6.84E-04	0.017	3.45E-06	**0.658**	**1.327**	0.0030	0.016	0.034	0.0047	0.0120	0.000025	0.0006
peppers, non-bell	17.4	3.97	1.42	6.96E-04	0.008	3.51E-06	**0.669**	0.882	0.0031	0.017	0.023	5E-03	1E-02	3E-05	6E-04
E) cranberry	0	0	0	0.00E+00	0.000	0.00E+00	0.000	0.000	0.0000	0.000	0.000	0E+00	0E+00	0E+00	0E+00
F) soybeans	10.8	4.51	1.65	4.32E-04	0.01	2.18E-06	**0.415**	**1.002**	0.0019	0.010	0.026	0.0030	0.0076	1.59E-05	0.0004
G) beans	15.1	6.21	2.38	6.04E-04	0.01	3.05E-06	**0.581**	**1.380**	0.0027	0.014	0.036	0.0041	0.0106	2.22E-05	0.0005
F3) cauliflower	37.5	8.21	2.89	1.50E-03	0.02	7.57E-06	**1.442**	**1.824**	0.0067	0.036	0.047	0.0103	0.0264	5.52E-05	0.0013
F4) celery	10.1	5.46	2.29	4.04E-04	0.01	2.04E-06	**0.388**	**1.213**	0.0018	0.010	0.031	0.0028	0.0071	1.49E-05	0.0003
G) mint	9	4.37	2.1	3.60E-04	0.01	1.82E-06	**0.346**	0.971	0.0016	0.009	0.025	0.0025	0.0063	1.33E-05	0.0003
H) peppers	29.3	0.438	0.339	1.17E-03	0.00	5.92E-06	**1.127**	0.097	0.0052	0.028	0.003	0.0080	0.0206	4.32E-05	0.0010
I) tobacco	11.2	3.83	1.58	4.48E-04	0.01	2.26E-06	**0.431**	0.851	0.0020	0.011	0.022	0.0031	0.0079	1.65E-05	0.0004
J) lettuce	16.7	8.48	3.38	6.68E-04	0.02	3.37E-06	**0.642**	**1.884**	0.0030	0.016	0.049	0.0046	0.0118	2.46E-05	0.0006
L) southern pine orchard seedlings	47.5	9.21	4.33	1.90E-03	0.03	9.59E-06	**1.827**	**2.047**	0.0084	0.045	0.053	0.0130	0.0335	7.00E-05	0.0016
M) paved areas	44.3	17.2	11	1.77E-03	0.06	8.94E-06	**1.704**	**3.822**	0.0079	0.042	0.099	0.0121	0.0312	0.0001	0.0015
M2) rights-of-way	3.02	1.33	1.08	1.21E-04	0.01	6.10E-07	**0.116**	0.296	0.0005	0.003	0.008	0.0008	0.0021	0.0000	0.0001
N) alfalfa	13	4.32	1.57	5.20E-04	0.01	2.62E-06	**0.500**	0.960	0.0023	0.012	0.025	0.0036	0.0092	0.0000	0.0004
O) grapes 1	31	14	11	1.24E-03	0.06	6.26E-06	**1.192**	**3.111**	0.0055	0.029	0.080	0.0085	0.0218	0.0000	0.0011
P) citrus 2	38.1	11.7	7.09	1.52E-03	0.04	7.69E-06	**1.465**	**2.600**	0.0068	0.036	0.067	0.0104	0.0268	0.0001	0.0013
Q) grapes 2	30.6	18.2	12.7	1.22E-03	0.07	6.18E-06	**1.177**	**4.044**	0.0054	0.029	0.105	0.0084	0.0215	0.0000	0.0010
R1) tree nuts, non-bearing	42.1	11.1	6.62	1.68E-03	0.04	8.50E-06	**1.619**	**2.467**	0.0075	0.040	0.064	0.0115	0.0296	0.0001	0.0014
R2) apples, non-bearing	15.7	7.87	6.57	6.28E-04	0.04	3.17E-06	**0.604**	**1.749**	0.0028	0.015	0.045	0.0043	0.0111	0.0000	0.0005
S) Bermuda grass	16.3	7	5.35	6.52E-04	0.031	3.29E-06	**0.627**	**1.556**	0.0029	0.015	0.040	0.0045	0.0115	0.0000	0.0006
T) Christmas trees	77.7	32	21.5	3.11E-03	0.13	1.57E-05	**2.988**	**7.111**	0.0138	**0.074**	0.184	0.0213	0.0547	0.0001	0.0026
U) citrus 1	200	56.3	29.5	8.00E-03	0.17	4.04E-05	**7.692**	**12.511**	0.0355	**0.190**	0.324	0.0548	0.1408	0.0003	0.0068
V) sod farms	36.2	15.9	12.9	1.45E-03	0.08	7.31E-06	**1.392**	**3.533**	0.0064	0.034	0.091	0.0099	0.0255	0.0001	0.0012
W) fire ants	82.7	36.3	29.4	3.31E-03	0.17	1.67E-05	**3.181**	**8.067**	0.0147	**0.078**	0.209	0.0227	0.0582	0.0001	0.0028
X) roses	971	285	180	3.88E-02	**1.06**	1.96E-04	**37.346**	**63.333**	**0.1725**	**0.921**	**1.638**	0.2660	0.6838	0.0014	0.0329
Y) ornamentals	1330	392	247	**5.32E-02**	**1.45**	2.69E-04	**51.154**	**87.111**	**0.2362**	**1.262**	**2.253**	0.3644	0.9366	0.0020	0.0451
AA) recreational lawns	943	414	336	3.77E-02	**1.98**	1.90E-04	**36.269**	**92.000**	**0.1675**	**0.895**	**2.379**	0.2584	0.6641	0.0014	0.0320
non-residential buidlings	1960	861	697	**7.84E-02**	**4.10**	3.96E-04	**75.385**	**191.333**	**0.3481**	**1.860**	**4.948**	0.5370	**1.3803**	0.0029	0.0664
non-residential buildings highest rate added (26x, 3d int.)	2530	1110	901	**1.01E-01**	**5.30**	5.11E-04	**97.308**	**246.667**	**0.4494**	**2.400**	**6.379**	0.6932	**1.7817**	0.0037	0.0858
non-residential buildings middle rate added (4x, monthly)	59.4	12.2	7.14	2.38E-03	0.04	1.20E-05	**2.285**	**2.711**	0.0106	**0.056**	0.070	0.0163	0.0418	0.0001	0.0020
non-residential buildings lowestt rate added (1x, 1 building)	0.010	0.0027	0.0003	4.00E-07	1.76E-06	2.02E-09	0.00038	0.00060	1.78E-06	9.49E-06	1.55E-05	2.74E-06	7.04E-06	1.47E-08	3.39E-07

Please note that this table is included for acephate and methamidophos comparisons and the application rates for some of the non-food uses are not up to date.

Using acephate toxicity endpoints:

	Acephate EEC's, in ug ai/L				RQs										
A + K) cotton	42.4	11.5	4.90	4.97E-05	8.31E-04	6.59E-06	0.039	0.077	0.0005	0.011	0.020	<0.00004075	0.00016751	<0.00004075	0.00004075
B) wasteland	48.8	18.2	12.4	5.72E-05	2.11E-03	7.58E-06	0.044	0.121	0.0006	0.013	0.031	<0.000046875	0.00019269	<0.000046875	4.6875E-05
D+I) peanuts, seed treatment	22.2	7.8	3.65	2.61E-05	6.19E-04	3.46E-06	0.020	0.052	0.0003	0.006	0.013	<0.000021375	8.7866E-05	<0.000021375	2.1375E-05
peppers, non-bell	22.6	5.2	1.85	2.65E-05	3.13E-04	3.52E-06	0.021	0.034	0.0003	0.006	0.009	<0.00002175	8.9407E-05	<0.00002175	0.00002175
E) cranberry	0.0	0.0	0.00	0.00E+00	0.00E+00	0.00E+00	0.000	0.000	0.0000	0.000	0.000	0	0	0	0
F) soybeans	14.0	5.9	2.15	1.65E-05	3.64E-04	2.18E-06	0.013	0.039	0.0002	0.004	0.010	<0.0000135	5.5494E-05	<0.0000135	0.0000135
G) beans	19.6	8.1	3.09	2.30E-05	5.24E-04	3.05E-06	0.018	0.054	0.0002	0.005	0.014	<0.000018875	7.7589E-05	<0.000018875	1.8875E-05
F3) cauliflower	48.8	10.7	3.76	5.72E-05	6.37E-04	7.58E-06	0.044	0.071	0.0006	0.013	0.018	<0.000046875	0.00019	<0.000046875	4.6875E-05
F4) celery	13.1	7.1	2.98	1.54E-05	5.05E-04	2.04E-06	0.012	0.047	0.0002	0.003	0.012	<0.000012625	5.1897E-05	<0.000012625	1.2625E-05
G) mint	11.7	5.7	2.73	1.37E-05	4.63E-04	1.82E-06	0.011	0.038	0.0001	0.003	0.010	<0.00001125	4.6245E-05	<0.00001125	0.00001125
H) peppers	38.1	0.6	0.44	4.47E-05	7.47E-05	5.92E-06	0.035	0.004	0.0004	0.010	0.001	<0.000036625	0.00015	<0.000036625	3.6625E-05
I) tobacco	14.6	5.0	2.05	1.71E-05	3.48E-04	2.26E-06	0.013	0.033	0.0002	0.004	0.009	<0.000014	5.7549E-05	<0.000014	0.000014
J) lettuce	21.7	11.0	4.39	2.55E-05	7.45E-04	3.37E-06	0.020	0.073	0.0003	0.006	0.019	<0.000020875	0.00009	<0.000020875	2.0875E-05
L) southern pine orchard seedlings	61.8	12.0	5.63	7.25E-05	9.54E-04	9.60E-06	**0.056**	0.080	0.0007	0.016	0.021	<0.000059375	0.00024	<0.000059375	5.9375E-05
M) paved areas	57.6	22.4	14.3	6.76E-05	2.42E-03	8.95E-06	**0.052**	0.149	0.0007	0.015	0.039	<0.000055375	0.00023	<0.000055375	5.5375E-05
M2) rights-of-way	3.9	1.7	1.40	4.61E-06	2.38E-04	6.10E-07	0.004	0.012	0.0000	0.001	0.003	<0.000003775	0.00002	<0.000003775	3.775E-06
N) alfalfa	16.9	5.6	2.04	1.98E-05	3.46E-04	2.63E-06	0.015	0.037	0.0002	0.004	0.010	<0.00001625	6.6798E-05	<0.00001625	0.00001625
O) grapes 1	40.3	18.2	14.3	4.73E-05	2.42E-03	6.26E-06	0.037	0.121	0.0005	0.011	0.031	<0.00003875	0.00016	<0.00003875	0.00003875
P) citrus 2	49.5	15.2	9.22	5.81E-05	1.56E-03	7.70E-06	0.045	0.101	0.0006	0.013	0.026	<0.000047625	0.00020	<0.000047625	4.7625E-05
Q) grapes 2	39.8	23.7	16.5	4.67E-05	2.80E-03	6.18E-06	0.036	0.158	0.0005	0.010	0.041	<0.00003825	0.00016	<0.00003825	0.00003825
R1) tree nuts, non-bearing	54.7	14.4	8.61	6.42E-05	1.46E-03	8.51E-06	**0.050**	0.096	0.0006	0.014	0.025	<0.000052625	0.00022	<0.000052625	5.2625E-05
R2) apples, non-bearing	20.4	10.2	8.54	2.40E-05	1.45E-03	3.17E-06	0.019	0.068	0.0002	0.005	0.018	<0.000019625	0.00008	<0.000019625	1.9625E-05
S) Bermuda grass	21.2	9.10	6.96	2.49E-05	1.18E-03	3.29E-06	0.019	0.061	0.0002	0.006	0.016	<0.000020375	8.3755E-05	<0.000020375	2.0375E-05
T) Christmas trees	101	41.6	28.0	1.19E-04	4.74E-03	1.57E-05	**0.092**	0.277	0.0012	0.027	0.072	<0.000097125	0.00039925	<0.000097125	9.7125E-05
U) citrus 1	260	73.2	38.4	3.05E-04	6.50E-03	4.04E-05	**0.236**	0.488	0.0031	**0.068**	0.126	<0.00025	0.0010	<0.00025	0.00025
V) sod farms	47.1	20.7	16.8	5.52E-05	2.84E-03	7.32E-06	0.043	0.138	0.0006	0.012	0.036	<0.00005	0.0002	<0.00005	0.000045
W) fire ants	108	47.2	38.2	1.26E-04	6.48E-03	1.67E-05	**0.098**	0.315	0.0013	0.028	0.081	<0.000103375	0.0004	<0.000103375	0.00010338
X) roses	1262	371	234	1.48E-03	3.97E-02	1.96E-04	**1.148**	**2.470**	0.0149	**0.332**	0.639	<0.00121375	0.0050	<0.00121375	0.00121375
Y) ornamentals	1729	510	321	2.03E-03	5.44E-02	2.69E-04	**1.572**	**3.397**	0.0203	**0.455**	0.879	<0.00166	0.0068	<0.00166	0.001663
AA) recreational lawns	1226	538	437	1.44E-03	7.40E-02	1.91E-04	**1.114**	**3.588**	0.0144	**0.323**	0.928	<0.00118	0.0048	<0.00118	0.001179
non-residential buidlings	2548	1119	906	2.99E-03	1.54E-01	3.96E-04	**2.316**	**7.462**	0.0300	**0.671**	**1.930**	<0.00245	0.0101	<0.00245	0.00245

Numbers in purple text are < values.

Please note that this table is included for acephate and methamidophos comparisons and the application rates for some of the non-food uses are not up to date.

APPENDIX H. TREX, TerrPlant Inputs/Outputs

H.1. T-REX Input and Output for Foliar Spray and Output Summary Tables for Granular, In-Furrow and Seed Treatment forAcephate and Methamidophos

Acephate:

Peppers, non-bell:

TREX MODEL INPUTS

These values will be used in the calculation of exposure estimates for foliar, granular, liquid and/or
seed applications of pesticides.

Chemical Identity and Application Information

Chemical Name:	Acephate		
Seed Treatment? (Check if yes)	FALSE	Seeding Rate (lbs/acre)	
Use:	peppers, hot (paprika, chili, etc)		4.2
Product name and form:			
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%		
Application Rate (lb ai/acre)	0.5		
Half-life (days):	8.2		
Application Interval (days):	3		
Number of Applications:	2		
Are you assessing applications with variable rates or intervals?	no		

Assessed Species Inputs (optional, use defaults for RQs for national level assessments)

What body weight range is assessed (grams)?	Birds	Mammals
Small	20	15
Medium	100	35
Large	1000	1000

Endpoints

Avian

Endpoint	Toxicity value	Indicate test species below	Optional Test Organism Body weight (g)	Optional Test Species Name	Toxicity Value Reference (MRID)

LD50 (mg/kg-bw)	86.90	Other	00 Zebra Finch	48924601
LC50 (mg/kg-diet)	718.00	Other	
		Mallard duck	00 Japanese Quail	40910905
NOAEL (mg/kg-bw)				29691
NOAEC (mg/kg-diet)	5.00	Mallard duck		

Enter the Mineau et al. Scaling Factor 1.15

Mammalian

	Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams	35	350

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Table X. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	90.73	242.72	2.68	111.25	1.23	136.53	1.50	15.17	0.17	95.07	1.05	3.37	0.04
100	115.51	138.41	1.20	63.44	0.55	77.86	0.67	8.65	0.07	54.21	0.47	1.92	0.02
1000	163.16	61.97	0.38	28.40	0.17	34.86	0.21	3.87	0.02	24.27	0.15	0.86	0.01

Table X. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
718	213.12	0.30	97.68	0.14	119.88	0.17	13.32	0.02	83.47	0.12

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
5	213.12	42.62	97.68	19.54	119.88	23.98	13.32	2.66	83.47	16.69

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	396.73	203.19	0.51	93.13	0.23	114.30	0.29	12.70	0.03	79.58459	0.200599	2.822149	0.007113
35	321.00	140.43	0.44	64.37	0.20	78.99	0.25	8.78	0.03	55.0036	0.171351	1.950482	0.006076
1000	138.84	32.56	0.23	14.92	0.11	18.32	0.13	2.04	0.01	12.75278	0.091851	0.452226	0.003257

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients										
LC50 (ppm)	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	213.12	#DIV/0!	97.68	#DIV/0!	119.88	#DIV/0!	13.32	#DIV/0!	83.47	#DIV/0!

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds/ Large Insects		Arthropods	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
50	213.12	4.26	97.68	1.95	119.88	2.40	13.32	0.27	83.47	1.67

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted NOAEL	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	5.49	203.19	36.98	93.13	16.95	114.30	20.80	12.70	2.31	79.58	14.48	2.82	0.51
35	4.45	140.43	31.59	64.37	14.48	78.99	17.77	8.78	1.97	55.00	12.37	1.95	0.44
1000	1.92	32.56	16.93	14.92	7.76	18.32	9.52	2.04	1.06	12.75	6.63	0.45	0.24

Ornamentals:

Chemical Name:	Acephate
Seed Treatment? (Check if yes)	☐ Ornamentals
Use:	Ornamentals
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	21.8
Half-life (days):	8.2
Application Interval (days):	3
Number of Applications:	26
Are you assessing applications with variable rates or intervals?	no

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Table X. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	Short Grass EEC	Short Grass RQ	Tall Grass EEC	Tall Grass RQ	Broadleaf Plants EEC	Broadleaf Plants RQ	Fruits/Pods/Seeds EEC	Fruits/Pods/Seeds RQ	Arthropods EEC	Arthropods RQ	Granivore EEC	Granivore RQ
20	90.73	26566.15	292.80	12176.15	134.20	14943.46	164.70	1660.38	18.30	10405.08	114.68	368.97	4.07
100	115.51	15149.15	131.15	6943.36	60.11	8521.39	73.77	946.82	8.20	5933.42	51.37	210.40	1.82
1000	163.16	6782.47	41.57	3108.63	19.05	3815.14	23.38	423.90	2.60	2656.47	16.28	94.20	0.58

Table X. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

LC50	Short Grass EEC	Short Grass RQ	Tall Grass EEC	Tall Grass RQ	Broadleaf Plants EEC	Broadleaf Plants RQ	Fruits/Pods/Seeds EEC	Fruits/Pods/Seeds RQ	Arthropods EEC	Arthropods RQ
718	23326.15	32.49	10691.15	14.89	13120.96	18.27	1457.88	2.03	9136.08	12.72

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

NOAEC (ppm)	Short Grass EEC	Short Grass RQ	Tall Grass EEC	Tall Grass RQ	Broadleaf Plants EEC	Broadleaf Plants RQ	Fruits/Pods/Seeds EEC	Fruits/Pods/Seeds RQ	Arthropods EEC	Arthropods RQ
5	23326.15	4665.23	10691.15	2138.23	13120.96	2624.19	1457.88	291.58	9136.08	1827.22

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	396.73	22239.70	56.06	10193.20	25.69	12509.83	31.53	1389.98	3.50	8710.549	21.95565	308.8847	0.778569
35	321.00	15370.61	47.88	7044.86	21.95	8645.97	26.93	960.66	2.99	6020.155	18.75438	213.4807	0.665049
1000	138.84	3563.73	25.67	1633.38	11.76	2004.60	14.44	222.73	1.60	1395.794	10.05308	49.49624	0.356492

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients										
	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
LC50 (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	23326.15	#DIV/0!	10691.15	#DIV/0!	13120.96	#DIV/0!	1457.88	#DIV/0!	9136.08	#DIV/0!

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds/ Large Insects		Arthropods	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
50	23326.15	466.52	10691.15	213.82	13120.96	262.42	1457.88	29.16	9136.08	182.72

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted NOAEL	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	5.49	22239.70	4047.57	10193.20	1855.14	12509.83	2276.76	1389.98	252.97	8710.55	1585.30	308.88	56.22
35	4.45	15370.61	3457.41	7044.86	1584.65	8645.97	1944.79	960.66	216.09	6020.15	1354.15	213.48	48.02
1000	1.92	3563.73	1853.31	1633.38	849.43	2004.60	1042.49	222.73	115.83	1395.79	725.88	49.50	25.74

LD_{50}/sq ft Example Input and Output:

Chemical Identity and Application Information

Chemical Name:	Acephate
Seed Treatment? (Check if yes)	FALSE
Use:	Golf
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	4.77
Half-life (days):	8.2
Application Interval (days):	
Number of Applications:	
Are you assessing applications with variable rates or intervals?	no

LD50 ft-2

Application Type: Broadcast / Granular

Make sure to enter an application rate above

Do not use this input	
Do not use this input	4.77

LD50 ft-2

INPUTS	Do not overwrite these numbers.	
Application Rate:	4.77	**lbs / acre**
% A.I.:	100.00%	
Avian LD50 (20g):	90.73	**mg/kg bw**
(100g)	115.51	
(1000g)	163.16	
Mammalian LD50 (15g):	396.73	**mg/kg bw**
(35g)	321.00	
(1000g)	138.84	
Row Spacing:	30	**inches**
Bandwidth:	6	**inches**
Unincorporation:	100%	

Row/Band/In-furrow applications

Granular	
Intermediate Calculations	
# rows acre-1:	N/A
row length (ft):	N/A
lb ai/1000 ft row:	N/A
bandwidth (ft):	N/A
mg ai/ft2:	N/A
exposed mg ai/ft2:	N/A

LD50 ft-2		
	wgt class (grams)	
Avian	20	N/A
	100	N/A
	1000	N/A
Mammal	15	N/A
	35	N/A
	1000	N/A

N/A	
Intermediate Calculations	
mg a.i./1000 ft row:	N/A
bandwidth:	N/A
mg a.i./ft2:	N/A
exposed mg a.i./ft2:	N/A

N/A		
	wgt class (grams)	
Avian	20	N/A
	100	N/A
	1000	N/A
Mammal	15	N/A
	35	N/A
	1000	N/A

Broadcast applications
Granular

Intermediate Calculations		
mg ai/ft2:	49.67	
LD50 ft-2		
	wgt class (grams)	
Avian	20	27.37
	100	4.30
	1000	0.30
Mammal	15	8.35
	35	4.42
	1000	0.36

Methamidophos:

Peppers, non-bell:

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Table X. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	5.31	188.73	35.53	86.50	16.28	106.16	19.99	11.80	2.22	73.92	13.92	2.62	0.49
100	6.76	107.62	15.91	49.33	7.29	60.54	8.95	6.73	0.99	42.15	6.23	1.49	0.22
1000	9.55	48.18	5.04	22.08	2.31	27.10	2.84	3.01	0.32	18.87	1.98	0.67	0.07

Table X. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
42	165.72	3.95	75.95	1.81	93.22	2.22	10.36	0.25	64.91	1.55

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
3	165.72	55.24	75.95	25.32	93.22	31.07	10.36	3.45	64.91	21.64

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients														
Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	34.29	158.00	4.61	72.42	2.11	88.87	2.59	9.87	0.29	61.8825	1.8049	2.1944	0.064
35	27.74	109.20	3.94	50.05	1.80	61.42	2.21	6.82	0.25	42.7691	1.5417	1.5166	0.0547
1000	12.00	25.32	2.11	11.60	0.97	14.24	1.19	1.58	0.13	9.91616	0.8264	0.3516	0.0293

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients										
LC50 (ppm)	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	165.72	#DIV/0!	75.95	#DIV/0!	93.22	#DIV/0!	10.36	#DIV/0!	64.91	#DIV/0!

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds/ Large Insects		Arthropods	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
10	165.72	16.57	75.95	7.60	93.22	9.32	10.36	1.04	64.91	6.49

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted NOAEL	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	1.10	158.00	143.78	72.42	65.90	88.87	80.87	9.87	8.99	61.88	56.31	2.19	2.00
35	0.89	109.20	122.81	50.05	56.29	61.42	69.08	6.82	7.68	42.77	48.10	1.52	1.71
1000	0.38	25.32	65.83	11.60	30.17	14.24	37.03	1.58	4.11	9.92	25.78	0.35	0.91

Ornamentals:

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Table X. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	5.31	16768.13	3156.64	7685.39	1446.79	9432.07	1775.61	1048.01	197.29	6567.52	1236.35	232.89	43.84
100	6.76	9561.90	1413.96	4382.54	648.07	5378.57	795.36	597.62	88.37	3745.08	553.80	132.80	19.64
1000	9.55	4280.99	448.17	1962.12	205.41	2408.06	252.09	267.56	28.01	1676.72	175.53	59.46	6.22

Table X. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
42	14723.10	350.55	6748.09	160.67	8281.74	197.18	920.19	21.91	5766.55	137.30

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
3	14723.10	4907.70	6748.09	2249.36	8281.74	2760.58	920.19	306.73	5766.55	1922.18

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	34.29	14037.35	409.42	6433.78	187.65	7896.01	230.30	877.33	25.59	5497.96	160.3551	194.9631	5.686351
35	27.74	9701.68	349.72	4446.60	160.29	5457.20	196.72	606.36	21.86	3799.826	136.9743	134.7456	4.857245
1000	12.00	2249.37	187.46	1030.96	85.92	1265.27	105.45	140.59	11.72	881.003	73.42362	31.24124	2.603674

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients										
	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
LC50 (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	14723.10	#DIV/0!	6748.09	#DIV/0!	8281.74	#DIV/0!	920.19	#DIV/0!	5766.55	#DIV/0!

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients										
NOAEC (ppm)	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds/ Large Insects		Arthropods	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
10	14723.10	1472.31	6748.09	674.81	8281.74	828.17	920.19	92.02	5766.55	576.65

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients													
Size Class (grams)	Adjusted NOAEL	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	1.10	14037.35	12773.82	6433.78	5854.67	7896.01	7185.27	877.33	798.36	5497.96	5003.08	194.96	177.41
35	0.89	9701.68	10911.32	4446.60	5001.02	5457.20	6137.61	606.36	681.96	3799.83	4273.60	134.75	151.55
1000	0.38	2249.37	5848.89	1030.96	2680.74	1265.27	3290.00	140.59	365.56	881.00	2290.82	31.24	81.23

LD_{50}/sq ft Example Input and Output:

TREX MODEL INPUTS	
These values will be used in the calculation of exposure estimates for foliar, granular, liquid and/or seed applications of pesticides.	
Chemical Identity and Application Information	
Chemical Name:	Methamidophos
Seed Treatment? (Check if yes)	FALSE
Use:	Golf Turf
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	3.67
Half-life (days):	6.5
Application Interval (days):	
Number of Applications:	1
Are you assessing applications with variable rates or intervals?	no

LD50 ft-2

Application Type: Broadcast / Granular

Make sure to enter an application rate above

Do not use this input	
Do not use this input	3.67
% incorporated	0.00%

Chemical: Methamidophos

LD50 ft-2

INPUTS	Do not overwrite these numbers.	
Application Rate:	3.67	lbs / acre
% A.I.:	100.00%	
Avian LD50 (20g):	5.31	mg/kg bw
(100g)	6.76	
(1000g)	9.55	
Mammalian LD50 (15g):	34.29	mg/kg bw

(35g)	27.74	
(1000g)	12.00	
Row Spacing:	30	inches
Bandwidth:	6	inches
Unincorporation:	100%	

Row/Band/In-furrow applications

Granular	
Intermediate Calculations	
# rows acre-1:	N/A
row length (ft):	N/A
lb ai/1000 ft row:	N/A
bandwidth (ft):	N/A
mg ai/ft2:	N/A
exposed mg ai/ft2:	N/A

LD50 ft-2		
	wgt class (grams)	
Avian	20	N/A
	100	N/A
	1000	N/A
Mammal	15	N/A
	35	N/A
	1000	N/A

N/A	
Intermediate Calculations	
mg a.i./1000 ft row:	N/A
bandwidth:	N/A
mg a.i./ft2:	N/A
exposed mg a.i./ft2:	N/A

N/A		
	wgt class (grams)	
Avian	20	N/A
	100	N/A
	1000	N/A
Mammal	15	N/A
	35	N/A
	1000	N/A

Broadcast applications
Granular

Intermediate Calculations	
mg ai/ft2:	38.22

LD50 ft-2		
	wgt class (grams)	
Avian	20	359.71
	100	56.51
	1000	4.00
Mammal	15	74.31
	35	39.36
	1000	3.18

LD_{50}/ft^2 Values Derived Using T-REX for Acephate

Use (Application Rate)	Application Type	RQ at Application Site					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Cotton (1 lb a.i./A)	Soil in-furrow, liquid	**28.7**	**4.51**	**0.32**	**8.75**	**4.63**	**0.37**
Golf Course Turf (4.77 lb a.i./A)	Broadcast, granular	**27.4**	**4.30**	**0.30**	**8.35**	**4.42**	**0.36**
Beans / peppers / brussels sprouts / cauliflower / celery / citrus / lettuce / mint / peanuts (1 lb a.i./A)	Broadcast, liquid	**5.74**	**0.90**	0.06	**1.75**	**0.93**	0.07

Bold dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); **bold** orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.

LD_{50}/ft^2 Values Derived Using T-REX for Methamidophos

Use (Application Rate)	Application Type	RQ at Application Site					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Cotton (1 lb a.i./A)	Soil in-furrow, liquid	**377**	**59.3**	**4.2**	**78.0**	**41.3**	**3.3**
Golf Course Turf (4.77 lb a.i./A)	Broadcast, granular	**354**	**55.6**	**3.9**	**73.1**	**38.7**	**3.1**
Beans / peppers / brussels sprouts / cauliflower / celery / citrus / lettuce / mint / peanuts (1 lb a.i./A)	Broadcast, liquid	**75.5**	**11.9**	**0.8**	**15.6**	**8.3**	**0.7**

Bold dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); **bold** orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.

Acute and Chronic Seed Treatment RQs Derived Using T-REX Based on Acephate Exposure.

Use (Application Rate)	RQs for Birds and Mammals Consuming Treated Seeds*						Chronic Dietary Based RQs[3]
	Acute Based on Dose vs. Max. Seed App. Rate[1]			Acute Based on Dose vs. Available Pesticide/sq. Ft[2]			
	S	M	L	S	M	L	
Birds							
Cotton (0.320 lbs a.i./cwt)	**9.3**	**4.2**	**1.3**	**0.36***	<0.1	<0.1	**666**
Peanuts (0.197 lb a.i./cwt)	**5.7**	**2.6**	**0.81**	**2.7**	**0.42***	<0.1	**410**
Mammals							
Cotton (0.320 lbs a.i./cwt)	**1.0**	**0.85**	**0.46***	<0.1	<0.1	<0.1	**128**
Peanuts (0.197 lb a.i./cwt)	**0.62**	**0.53**	**0.28***	**0.46***	**0.24***	<0.1	**79**

S = Small (20g for birds, 15g for mammals); M = Medium (100g for birds, 35g for mammals); L = Large (1000g for birds and mammals). **Bold** dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); **bold** orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.

[1] Based on EEC calculated for each size class by TREX from maximum seed application rate (3332 mg ai/kg seed for cotton and 2050 mg ai/kg seed for peanuts) and acute oral toxicity values (zebra finch LD_{50} = 46.9 mg/kg-bw; meadow vole LD_{50} = 321 mg/kg-bw).

[2] Based on EEC per sq. ft from TREX calculations and acute oral toxicity values (zebra finch LD_{50} = 46.9 mg/kg-bw; meadow vole LD_{50} = 321 mg/kg-bw).
[3] Based on dietary-based EEC and Mallard duck NOAEC = 5 mg/kg-diet.

Acute and Chronic Seed Treatment RQs Derived Using T-REX Based on Methamidophos Exposure.

Use (Application Rate)	RQs for Birds and Mammals Consuming Treated Seeds*						Chronic Dietary Based RQs[3]
	Acute Based on Dose vs. Max. Seed App. Rate[1]			Acute Based on Dose vs. Available Pesticide/sq. Ft[2]			
	S	M	L	S	M	L	
Birds							
Cotton (0.320 lbs a.i./cwt)	**122**	**55**	**17**	**4.8**	**0.75**	<0.1	**855**
Peanuts (0.197 lb a.i./cwt)	**75**	**34**	**11**	**35**	**5.6**	**0.39***	**527**
Mammals							
Cotton (0.320 lbs a.i./cwt)	**15.8**	**14**	**7.3**	**0.98**	**0.52**	<0.1	**494**
Peanuts (0.197 lb a.i./cwt)	**9.8**	**8.4**	**4.5**	**7.3**	**3.9**	**0.31***	**305**

S = Small (20g for birds, 15g for mammals); M = Medium (100g for birds, 35g for mammals); L = Large (1000g for birds and mammals). **Bold** dark-pink-shaded RQs exceed the LOCs (0.5 for acute and 1.0 for chronic risk); **bold** orange-shaded RQs with an asterisk exceed only the listed species LOC (0.1) for acute risk.
[1] Based on EEC calculated for each size class by TREX from maximum seed application rate (2464 mg ai/kg seed for cotton and 1581 mg ai/kg seed for peanuts) and acute oral toxicity values (grackle LD_{50} = 6.7 mg/kg-bw; rat LD_{50} = 15.6 mg/kg-bw).
[2] Based on EEC per sq. ft from TREX calculations and acute oral toxicity values (grackle LD_{50} = 6.7 mg/kg-bw; rat LD_{50} = 15.6 mg/kg-bw).
[3] Based on dietary-based EEC and Mallard duck NOAEC = 3 mg/kg-diet.

Calculations of Exposure from Treated-Seed Consumption Based on Test Organism Weights.

Crop	lb a.i./cwt [1]	# seeds / lb-seed[2]	mg ai/seed [3]	LD_{50}, mg ai/kg-bw	Study	Bw of test org, kg	mg ai for LD_{50}[4]	1 seed RQ[5]	# seeds for LD_{50}[6]
Acephate									
Cotton	0.32	4500	0.323	86.9	Zebra finch	0.015	1.30	0.25	**4.04**
Peanuts	0.197	907	0.985	321	Meadow vole	0.035	11.2	0.09	**11.4**
Methamidophos									
Cotton	0.246	4500	0.248	6.7	Grackle	0.094	0.630	0.39	**2.54**
Peanuts	0.152	907	0.760	15.6	Rat	0.35	5.46	0.14	**7.18**

[1] From TREX; cwt – hundredweight (100 lbs seed).
[2] From Table B-1., pp. 81- of Becker and Ratnayake (2011); for peanuts used the most recently cited value (907).
[3] Calculation: lb ai/cwt * cwt/100 lb-seed ÷ # seeds/lb-seed * 453592 mg/lb = mg ai/seed.
[4] Calculation: LD50 in mg ai/kg-bw * kg-bw (of test organism) = mg ai to reach LD_{50} in test organism.
[5] Calculation: mg ai/seed ÷ mg ai for LD_{50} = RQ estimate for consumption of one seed.
[6] Calculation: mg ai for LD_{50} ÷ mg ai/seed = # seeds needed to be consumed to reach LD_{50}.

Risk Quotients for Birds and Mammals from Treated-Seed Consumption.

Seed Treatment	Bird and Mammal Size Classes					
	Small Bird 20g	**Medium Bird 100 g**	**Large Bird 1000g**	**Small Mammal 15g**	**Medium Mammal 35g**	**Large Mammal 1000g**
Acephate						
Adjusted LD_{50} For Each Size Class						
LD_{50}, mg/kg-bw[1]	90.7	116	163	706	571	247
Number of Seeds Needed to Be Consumed to Reach LD_{50}[2]						
Cotton	**5.63**	**35.8**	**506**	**32.8**	**61.9**	**765**
Peanuts	**1.84**	**11.7**	**166**	**10.7**	**20.3**	**251**
Methamidophos						
Adjusted LD_{50} For Each Size Class						
LD_{50}, mg/kg-bw[1]	5.31	6.76	9.55	34.3	27.7	12.0
Number of Seeds Needed to Be Consumed to Reach LD_{50}[2]						
Cotton	**0.43**	**2.73**	**38.5**	**2.07**	**3.92**	**48.4**
Peanuts	**0.14**	**0.89**	**12.6**	**0.68**	**1.28**	**15.8**

[1] From TREX.

[2] Calculation: Adjusted LD_{50} mg ai/kg-bw * kg-bw (size class in g ÷1000) ÷ mg ai/seed = # seeds needed to reach LD_{50}.

Terrestrial Invertebrate Calculations:

RQs for Terrestrial Invertebrates Based on Acephate Exposure.

Use [Method of Application, Application Rate (lbs a.i./acre), # of app, App interval (days)]	EEC[1] for honeybee (ug a.i./bee)	RQ (based on honey bee data)[2]	EEC[3] for small insect (µg a.i./g)	RQ (based on Soybean looper data)[4]
Peppers, non-bell [aerial, 0.5, 2, 3]	1.4	**1.1**	83.5	**4.1**
Celery/mint [aerial, 1.0, 2, 3]	2.7	**2.3**	167	**8.2**
Citrus [airblast, 4.0, 26, 7]	10.8	**9.0**	842	**42**
Ornamentals [ground, 21.8, 26, 3]	58.9	**49.1**	9140	**450**

Bold dark-pink-shaded RQs exceed the LOC (0.4 for acute risk).
[1] Based on new guidance (USEPA, 2014);[18] calculation for Tier I contact toxicity – Application Rate (in lb a.i./A)*2.7 = EEC (in ug a.i./bee).
[2] Based on honey bee toxicity endpoint: RQ = EEC/LD_{50} (LD_{50} of 1.20 ug a.i./bee).
[3] Small insect EEC from TREX.
[4] Based on Soybean looper larvae toxicity data: RQ = EEC/LD_{50} (20.3 µg a.i./g of larvae).

RQs for Terrestrial Invertebrates Based on Methamidophos Exposure.

Use [Method of Application, Application Rate (lbs a.i./acre), # of app, App interval (days)]	EEC[1] for honeybee (ug a.i./bee)	RQ (based on honey bee data)[2]	EEC[3] for small insect (µg a.i./g)	RQ (based on budworm data)[4]
Peppers, non-bell [aerial, 0.4, 2, 3]	1.1	**0.8**	64.9	**8.7**
Celery/mint [aerial, 0.8, 2, 3]	2.2	**1.6**	125	**16.8**
Citrus [airblast, 3.1, 26, 7]	8.4	**6.1**	554	**74**
Ornamentals [ground, 16.8, 26, 3]	45.4	**33.1**	5770	**774**

Bold dark-pink-shaded RQs exceed the LOC (0.4 for acute risk).
[1] Based on new guidance (USEPA, 2014);[19] calculation for Tier I contact toxicity – Application Rate (in lb a.i./A)*2.7 = EEC (in ug a.i./bee).
[2] Based on honey bee toxicity endpoint: RQ = EEC/LD_{50} (LD_{50} of 1.37 ug a.i./bee).
[3] Small insect EEC from TREX.
[4] Based on Western spruce budworm larvae toxicity data: RQ = EEC/LD_{50} (7.45 µg a.i./g of larvae).

[18] http://www2.epa.gov/sites/production/files/2014-6/documents/pollinator_risk_assessment_guidance_06_19_14.pdf
[19] http://www2.epa.gov/sites/production/files/2014-6/documents/pollinator_risk_assessment_guidance_06_19_14.pdf

H.2. TerrPlant Input and Output

TerrPlant v. 1.2.2 **Green values signify user inputs (Tables 1, 2 and 4).**

Input and output guidance is in popups indicated by red arrows.

Note: All EC_{25}s reported for acephate were > values and so the RQs calculated for Non-Listed Species are < the calculated number. The program does not allow for < or > values to be input so this was adjusted later. These RQs are upper bound estimates.

Table 1. Chemical Identity.	
Chemical Name	Acephate
PC code	103301
Use	Non-bell Peppers
Application Method	Aerial
Application Form	Liquid
Solubility in Water (ppm)	835000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**0.5**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.025
Runoff to semi-aquatic areas	(A/I)*R*10	0.25
Spray drift	**A*D**	**0.025**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.05**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.275**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.1	<0.1
Monocot	listed	<0.1	<0.1	<0.1
Dicot	non-listed	<0.1	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Table 1. Chemical Identity.	
Chemical Name	Acephate
PC code	103301
Use	Celery
Application Method	Aerial
Application Form	Liquid
Solubility in Water (ppm)	835000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**1**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.05
Runoff to semi-aquatic areas	(A/I)*R*10	0.5
Spray drift	**A*D**	**0.05**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.1**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.55**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.14	<0.1
Monocot	listed	<0.1	0.14	<0.1
Dicot	non-listed	<0.1	<0.14	<0.1
Dicot	listed	<0.1	0.14	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Table 1. Chemical Identity.	
Chemical Name	**Acephate**
PC code	**103301**
Use	**Citrus**
Application Method	**Airblast**
Application Form	**Liquid**
Solubility in Water (ppm)	**835000**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**4**	**y**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.2
Runoff to semi-aquatic areas	(A/I)*R*10	2
Spray drift	**A*D**	**0.2**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.4**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**2.2**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.10	<0.56	<0.1
Monocot	listed	0.10	0.56	<0.1
Dicot	non-listed	<0.10	<0.56	<0.1
Dicot	listed	0.10	0.56	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Table 1. Chemical Identity.	
Chemical Name	**Acephate**
PC code	**103301**
Use	**Ornamentals**
Application Method	**Ground**
Application Form	**Liquid**
Solubility in Water (ppm)	**835000**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**21.8**	**y**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	1.09
Runoff to semi-aquatic areas	(A/I)*R*10	10.9
Spray drift	**A*D**	**0.218**
Total for dry areas	**((A/I)*R)+(A*D)**	**1.308**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**11.118**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.33	**<2.81**	<0.1
Monocot	listed	0.33	**2.81**	<0.1
Dicot	non-listed	<0.33	**<2.81**	<0.1
Dicot	listed	0.33	**2.81**	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Methamidophos
PC code	101201
Use	Non-bell Peppers
Application Method	Aerial
Application Form	Liquid
Solubility in Water (ppm)	200000

Table 2. Input parameters used to derive EECs.

Input Parameter	Symbol	Value	Units
Application Rate	A	**0.4**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Methamidophos. Units in y.

Description	Equation	EEC
Runoff to dry areas	(A/I)*R	0.02
Runoff to semi-aquatic areas	(A/I)*R*10	0.2
Spray drift	**A*D**	**0.02**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.04**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.22**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.

	Seedling Emergence		Vegetative Vigor	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	4	4	4	4
Dicot	4	4	4	4

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	<0.1	<0.1	<0.1
Monocot	listed	<0.1	<0.1	<0.1
Dicot	non-listed	<0.1	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1

*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.

Table 1. Chemical Identity.	
Chemical Name	Methamidophos
PC code	101201
Use	Celery
Application Method	Aerial
Application Form	Liquid
Solubility in Water (ppm)	200000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**0.8**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.04
Runoff to semi-aquatic areas	(A/I)*R*10	0.4
Spray drift	**A*D**	**0.04**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.08**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.44**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	4	4	4	4
Dicot	4	4	4	4

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	0.11	<0.1
Monocot	listed	<0.1	0.11	<0.1
Dicot	non-listed	<0.1	0.11	<0.1
Dicot	listed	<0.1	0.11	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Table 1. Chemical Identity.	
Chemical Name	Methamidophos
PC code	101201
Use	Citrus
Application Method	Airblast
Application Form	Liquid
Solubility in Water (ppm)	200000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**3.1**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.155
Runoff to semi-aquatic areas	(A/I)*R*10	1.55
Spray drift	**A*D**	**0.155**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.31**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**1.705**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	4	4	4	4
Dicot	4	4	4	4

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	0.43	<0.1
Monocot	listed	<0.1	0.43	<0.1
Dicot	non-listed	<0.1	0.43	<0.1
Dicot	listed	<0.1	0.43	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Table 1. Chemical Identity.	
Chemical Name	Methamidophos
PC code	101201
Use	Ornamentals
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	200000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**16.8**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.84
Runoff to semi-aquatic areas	(A/I)*R*10	8.4
Spray drift	**A*D**	**0.168**
Total for dry areas	**((A/I)*R)+(A*D)**	**1.008**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**8.568**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	4	4	4	4
Dicot	4	4	4	4

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	0.25	**2.14**	<0.1
Monocot	listed	0.25	**2.14**	<0.1
Dicot	non-listed	0.25	**2.14**	<0.1
Dicot	listed	0.25	**2.14**	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Acephate
PC code	103301
Use	Golf Course Turf
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	835000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**4.77**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.2385
Runoff to semi-aquatic areas	(A/I)*R*10	2.385
Spray drift	**A*D**	**0.0477**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.2862**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**2.4327**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.61	<0.1
Monocot	listed	<0.1	0.61	<0.1
Dicot	non-listed	<0.1	<0.61	<0.1
Dicot	listed	<0.1	0.61	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Methamidophos
PC code	101201
Use	Golf Course Turf
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	200000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**3.67**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.1835
Runoff to semi-aquatic areas	(A/I)*R*10	1.835
Spray drift	**A*D**	**0.0367**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.2202**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**1.8717**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	>4	4	>4	4
Dicot	>4	4	>4	4

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.47	<0.1
Monocot	listed	<0.1	0.47	<0.1
Dicot	non-listed	<0.1	<0.47	<0.1
Dicot	listed	<0.1	0.47	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Acephate
PC code	103301
Use	Fire Ants
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	835000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**6.84**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.342
Runoff to semi-aquatic areas	(A/I)*R*10	3.42
Spray drift	**A*D**	**0.0684**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.4104**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**3.4884**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.10	<0.88	<0.1
Monocot	listed	0.10	0.88	<0.1
Dicot	non-listed	<0.10	<0.88	<0.1
Dicot	listed	0.10	0.88	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	**Methamidophos**
PC code	**101201**
Use	**Fire Ants**
Application Method	**Ground**
Application Form	**Liquid**
Solubility in Water (ppm)	**200000**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**5.27**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.2635
Runoff to semi-aquatic areas	(A/I)*R*10	2.635
Spray drift	**A*D**	**0.0527**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.3162**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**2.6877**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC25**	**NOAEC**	**EC25**	**NOAEC**
Monocot	**>4**	**4**	**>4**	**4**
Dicot	**>4**	**4**	**>4**	**4**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.67	<0.1
Monocot	listed	<0.1	0.67	<0.1
Dicot	non-listed	<0.1	<0.67	<0.1
Dicot	listed	<0.1	0.67	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Acephate
PC code	103301
Use	Non-Residential Buildings
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	835000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**10.1**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.505
Runoff to semi-aquatic areas	(A/I)*R*10	5.05
Spray drift	**A*D**	**0.101**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.606**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**5.151**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC25**	**NOAEC**	**EC25**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.15	<1.30	<0.1
Monocot	listed	0.15	1.30	<0.1
Dicot	non-listed	<0.15	<1.30	<0.1
Dicot	listed	0.15	1.30	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	**Methamidophos**
PC code	**101201**
Use	**Non-Residential Buildings**
Application Method	**Ground**
Application Form	**Liquid**
Solubility in Water (ppm)	**200000**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**7.78**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.389
Runoff to semi-aquatic areas	(A/I)*R*10	3.89
Spray drift	**A*D**	**0.0778**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.4668**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**3.9678**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC25**	**NOAEC**	**EC25**	**NOAEC**
Monocot	**>4**	**4**	**>4**	**4**
Dicot	**>4**	**4**	**>4**	**4**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.12	<0.99	<0.1
Monocot	listed	0.12	0.99	<0.1
Dicot	non-listed	<0.12	<0.99	<0.1
Dicot	listed	0.12	0.99	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Acephate
PC code	103301
Use	Roses
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	835000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**15.9**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Acephate. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.795
Runoff to semi-aquatic areas	(A/I)*R*10	7.95
Spray drift	**A*D**	**0.159**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.954**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**8.109**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC25**	**NOAEC**	**EC25**	**NOAEC**
Monocot	**>3.96**	**3.96**	**>3.96**	**3.96**
Dicot	**>3.96**	**3.96**	**>3.96**	**3.96**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Acephate through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.24	<2.05	<0.1
Monocot	listed	0.24	2.05	<0.1
Dicot	non-listed	<0.24	<2.05	<0.1
Dicot	listed	0.24	2.05	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

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Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Methamidophos
PC code	101201
Use	Roses
Application Method	Ground
Application Form	Liquid
Solubility in Water (ppm)	200000

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**12.2**	y
Incorporation	I	**1**	none
Runoff Fraction	R	**0.05**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Methamidophos. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.61
Runoff to semi-aquatic areas	(A/I)*R*10	6.1
Spray drift	**A*D**	**0.122**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.732**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**6.222**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	>4	4	>4	4
Dicot	>4	4	>4	4

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Methamidophos through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.18	<1.56	<0.1
Monocot	listed	0.18	1.56	<0.1
Dicot	non-listed	<0.18	<1.56	<0.1
Dicot	listed	0.18	1.56	<0.1

*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.